# GPLUS EDUCATION

**Date :**
**Time :** **CHEMISTRY**
**Marks :**

## THERMODYNAMICS

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**Single Correct Answer Type**

1. Standard enthalpy of vapourisation $\Delta_{vap.}H^{\ominus}$ for water at 100°C is 40.66 kJ $mol^{-1}$. The internal energy of vapourisation of water at 100°C (in kJ $mol^{-1}$) is:
   a) +43.76 b) +40.66 c) +37.56 d) −43.76
2. The factor $\left(\frac{\partial Q}{\partial T}\right)_P - \left(\frac{\partial Q}{\partial T}\right)_V$ is equal to :
   a) $\gamma$ b) $R$ c) $\frac{R}{M}$ d) $\Delta nRT$
3. Heat of combustion of a substance:
   a) Is always positive b) Is always negative
   c) Is equal to heat of formation d) Nothing can be said without reaction
4. The heat of formations of CO(g) and $CO_2$(g) are −26.4 kcal and −94.0 kcal respectively. The heat of combustion of carbon monoxide will be
   a) −67.6 kcal b) 36.5 kcal c) −36.5 kcal d) −46.5 kcal
5. Which reaction either endothermic or exothermic characteristics has the greater chance of occurring spontaneously?
   a) One in which entropy change is positive
   b) One is which entropy change is negative
   c) One in which Gibbs energy change is negative
   d) One in which equilibrium has been established
6. Net work done by the system in a cyclic process is equal to:
   a) Zero b) $\Delta U$ c) $\Delta H$ d) $q$
7. A thermodynamic quantity is that:
   a) Which is used in thermochemistry
   b) Which obeys all the laws of thermodynamics
   c) Quantity which depends only on the state of the system
   d) Quantity which is used in measuring thermal change
8. The Gibbs energy change for a reversible reaction at equilibrium is:
   a) Zero b) Small positive c) Small negative d) Large positive
9. If, $S + O_2 \rightarrow SO_2$; $\Delta H = -298.2$ kJ $\ldots(i)$
   $SO_2 + \frac{1}{2}O_2 \rightarrow SO_3$; $\Delta H = -98.7$ kJ $\ldots(ii)$
   $SO_3 + H_2O \rightarrow H_2SO_4$; $\Delta H = -130.2$ kJ $\ldots(iii)$
   $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$; $\Delta H = -227.3$ kJ $\ldots(iv)$
   The enthalpy of formation of $H_2SO_4$ at 298 K will be:
   a) − 754.4 kJ
   b) + 320.5 kJ
   c) − 650.3 kJ
   d) − 433.7 kJ
10. The heat required to raise the temperature of a body by 1 K is called
    a) Specific heat b) Thermal capacity c) Water equivalent d) None of these
11. A system absorbs 10 kJ of heat and does 4 kJ of work. The internal energy of the system

a) Increases by 6 kJ b) Decreases by 6 kJ c) Decreases by 14 kJ d) Increases by 14 kJ

12. Which of the following statement is true?
    a) $\Delta H$ is positive for exothermic reactions
    b) $\Delta H$ is negative for endothermic reactions
    c) The enthalpy of fusion is negative
    d) The heat of neutralization of strong acid with strong base is always the same
13. The temperature at which the reaction,
    $Ag_2O(s) \rightarrow 2Ag(s) + \frac{1}{2}O_2(g)$
    Is at equilibrium is ...;gives, $\Delta H = 30.5$ kJ mol$^{-1}$ and $\Delta S = 0.066$ kJ K$^{-1}$mol$^{-1}$.
    a) 462.12 K b) 362.12 K c) 262.12 K d) 562.12 K
14. During an adiabatic process:
    a) Pressure is maintained constant
    b) Gas is isothermally expanded
    c) There is perfect heat insulation
    d) The system changes heat with surroundings
15. If $CH_3COOH + OH^- = CH_3COO^- + H_2O + q_1$ and $H^+ + OH^- = H_2O + q_2$,then the enthalpy change for the reaction , $CH_3COOH = CH_3COO^- + H^+$ is equal to :
    a) $q_1 + q_2$ b) $q_1 - q_2$ c) $q_2 - q_1$ d) $-q_1 - q_2$
16. Which of the following statements is true? The entropy of the universe
    a) Increases and tends towards maximum value b) Decreases and tends to be zero
    c) Remains constant d) Decreases and increases with a periodic rate
17. The standard change is Gibbs energy for the reaction,
    $H_2O \rightleftharpoons H^+ + OH^-$ at 25°C is:
    a) 100 kJ b) −90 kJ c) 90 kJ d) −100 kJ
18. Which is not characteristic of thermochemical equation?
    a) It indicates physical state of reactants and products
    b) It indicates whether the reaction is exothermic or endothermic
    c) It indicates allotrope of reactants if present
    d) It indicates whether reaction would occur or not
19. For the reaction,
    $H_2(g) + Cl_2(g) \rightarrow 2HCl(g) + x_1$ kJ ... ... ... (i)
    $2HCl(g) \rightarrow H_2(g) + Cl_2(g) - x_2$ kJ ... ... (ii)
    Which of the following statement is correct?
    a) $x_1$ and $x_2$ are numerically equal
    b) $x_1$ and $x_2$ are numerically different
    c) $x_1 - x_2 > 0$
    d) $x_1 - x_2 < 0$
20. For which process energy will be absorbed?
    a) Separation of an electron from an electron
    b) Separation of proton from a neutron
    c) Separation of a neutron from neutron
    d) Separation of an electron from a neutral atom
21. Which of the following is correct for an ideal gas :
    a) $\left(\frac{\partial E}{\partial T}\right)_V = 0$ b) $\left(\frac{\partial E}{\partial P}\right)_T = 0$ c) $\left(\frac{\partial E}{\partial T}\right)_P = 0$ d) All of these
22. An exothermic reaction is one in which the reacting substances
    a) Have more energy than the products b) Have less energy than the products
    c) Are at a higher temperature than the product d) None of the above

23. Heat energy change during the chemical reaction, $CO + \frac{1}{2} O_2 \longrightarrow CO_2$ is known as :
    a) Heat of combustion of CO
    b) Latent heat of $CO_2$
    c) Latent heat of vaporisation
    d) Heat of formation of $CO_2$
24. Under the same conditions how many mL of $1M$ KOH and 0.5 $M$ $H_2SO_4$ solutions, respectively when mixed for a total volume of 100 mL produce the highest rise in temperature?
    a) 67 : 33 b) 33 : 67 c) 40 : 60 d) 50 : 50
25. The first law of thermodynamic is expressed as
    a) $q - W = \Delta E$ b) $\Delta E = q - W$ c) $q = \Delta E - W$ d) $W = q + \Delta E$
26. 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, $\Delta U = 30.0$ L atm. The change in enthalpy ($\Delta H$) of the process in L atm is:
    a) 40.0
    b) 42.3
    c) 44.0
    d) Not defined, because pressure is not constant
27. Which one of the following is an exothermic reaction?
    a) $N_2(g) + O_2(g) + 180.8kJ \rightarrow 2NO(g)$ b) $N_2(g) + 3H_2(g) - 92kJ \rightarrow 2NH_3(g)$
    c) $C(g) + H_2O \rightarrow CO(g) + H_2(g) - 131.1kJ$ d) $C(graphite) + 2S(s) \rightarrow CS_2(l) - 91.9kJ$
28. If liquids $A$ and $B$ from an ideal solution, the:
    a) Enthalpy of mixing is zero
    b) Entropy of mixing is zero
    c) Free energy of mixing is zero
    d) Free energy as well as the entropy of mixing are each zero
29. In which of the following cases entropy decreases?
    a) Solid changing to liquid
    b) Expansion of a gas
    c) Crystals dissolve
    d) Polymerisation
30. For the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$: $\Delta H$ is
    a) $\Delta E - 2RT$ b) $\Delta E - RT$ c) $\Delta E + RT$ d) $\Delta E + 2RT$
31. When one mole of monoatomic ideal gas at $T$ temperature undergoes adiabatic change under a constant external pressure of 1 atm change in volume is from 1 L to 2 L, the final temperature in Kelvin would be
    a) $\frac{T}{2^{(2/3)}}$ b) $T + \frac{2}{3 \times 0.0821}$ c) $T$ d) $T - \frac{2}{3 \times 0.0821}$
32. In the combustion of 2.0 g of methane, 25 kcal heat is liberated. Heat of combustion of methane would be
    a) 150 kcal b) 200 kcal c) 250 kcal d) 350 kcal
33. 1 mole of an ideal gas at 25°C is subjected to expand reversibly ten times of its initial volume. The change in entropy of expansion is:
    a) 19.15 $JK^{-1}mol^{-1}$ b) 16.15 $JK^{-1}mol^{-1}$ c) 22.15 $JK^{-1}mol^{-1}$ d) None of these
34. The heat of formation ($\Delta H_f$) of $H_2O(l)$ is equal to:
    a) Zero
    b) Molar heat of combustion of $H_2(l)$
    c) Molar heat of combustion of $H_2(g)$
    d) Sum of heat of formation of $H_2O(g)$ and $O_2(g)$
35. The entropy change for the reaction given below,
    $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
    Is...at 300 K. Standard entropies of $H_2(g), O_2(g)$ and $H_2O(l)$ are 126.6, 201.20 and 68.0 $JK^{-1}mol^{-1}$

respectively.

a) $-318.4\ JK^{-1}mol^{-1}$ b) $318.4\ JK^{-1}mol^{-1}$ c) $31.84\ JK^{-1}mol^{-1}$ d) None of these

36. Heat of combustion $\Delta H$ for $C(s), H_2(g)$ and $CH_4(g)$ are $-94, -68$ and $-213$ kcal/mole then $\Delta H$ for $C(s) + 2H_2(g) \rightarrow CH_4(g)$ is :

a) $-17$ kcal b) $-111$ kcal c) $-170$ kcal d) $-85$ kcal

37. A positive change in enthalpy occurs in :

a) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$

b) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

c) $MgCO_3(s) \longrightarrow MgO(s) + CO_2(g)$

d) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$

38. A gas expands isothermally and reversibly. The work done by the gas is:

a) Zero b) Minimum c) Maximum d) Equal to work done

39. What is $\Delta n$ for combustion of 1 mole of benzene, when both the reactants and products are gas at 298 K

a) 0 b) 1 c) 0.5 d) 1.5

40. Internal energy and pressure of a gas of unit volume are related as:

a) $P = \frac{2}{3}U$ b) $P = \frac{3}{2}U$ c) $P = \frac{U}{2}$ d) $P = 2U$

41. A reaction accompanied with the absorption of energy is :

a) Burning of a candle b) Rusting of iron c) Electrolysis of water d) Digestion of food

42. The second law of thermodynamics introduced the concept of:

a) Third law of thermodynamics

b) Work

c) Entropy

d) Internal energy

43. The enthalpy change is negative for :

a) $Cl^-(g) + aq \longrightarrow Cl^-(aq)$

b) $Cl(g) \longrightarrow Cl^+(g) + e$

c) $\frac{1}{2}\ Cl_2(g) \longrightarrow Cl(g)$

d) $Cl_2(l) \longrightarrow Cl_2(g)$

44. Equal volumes of monoatomic and diatomic gases at same initial temperature and pressure are mixed. The ratio of specific heats of the mixture $(C_p/C_v)$ will be

a) 1 b) 2 c) 1.67 d) 1.2

45. If, $C(s) + O_2(g) \rightarrow CO_2(g),\ \Delta H = -393.5$ kJ and $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta H = -283.5$ kJ,

then the heat of formation of CO is:

a) $-110.0$ kJ b) 676.5 kJ c) $-676.5$ kJ d) 110.5 kJ

46. Hess's law of constant heat summation is an application of :

a) Kirchhoff's law

b) First law of thermodynamics

c) Second law of thermodynamics

d) Entropy

47. The heat of reaction at constant pressure is equal to :

a) $\Sigma U_P - \Sigma U_R$ b) $\Sigma U_R - \Sigma U_P$ c) $\Sigma H_P - \Sigma H_R$ d) $\Sigma H_R - \Sigma H_P$

48. Select the correct limitations of III law of thermodynamics.

a) Glassy solids at zero kelvin has entropy greater than zero

b) Solids having mixture of isotopes do not have entropy zero at zero kelvin

c) Crystals of CO, $N_2O$, NO, $H_2O$, etc., do not have zero entropy at zero kelvin

d) All of the above

49. Heat of formation of $H_2O(g)$ at 1 atm and 25°C is – 243 kJ. $\Delta U$ for the reaction, $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$ at 25°C is :
a) 241.8 kJ b) $-241.8$ kJ c) $-$ 243 kJ d) 243 kJ

50. Molar heat capacity of a gas at constant temperature and pressure is :
a) $(3/2)R$
b) $(5/2)R$
c) Infinite
d) Depends upon atomicity of gas

51. If water is formed from $H^+$ ions and $OH^-$, the heat of formation of water is :
a) $-13.7$ kcal b) $+13.7$ kcal c) $-63.4$ kcal d) $+63.4$ kcal

52. The process of evaporation of a liquid is accompanied by:
a) Increase in enthalpy
b) Decrease in Gibbs energy
c) Increase in entropy
d) All of the above

53. The work done during the process when 1 mole of gas is allowed to expand freely into vacuum is:
a) Zero b) +ve c) $-$ve d) Either of these

54. The van't Hoff reaction isotherm is:
a) $\Delta G = RT \log_e K_p$ b) $-\Delta G = RT \log_e K_p$ c) $\Delta G = RT^2 \ln K_p$ d) None of these

55. Which species have negative value of specific heat?
a) Ice b) Water c) Vapour d) Saturated vapour

56. The standard heat of formation of sodium ions in aqueous solution from the following data will be:
Heat of solution NaOH$(aq.)$ from NaOH$(s) = -470.7$ kJ
Heat of formation of $OH^-(aq.)$ From $OH^-(s) = -228.8$ kJ
a) $-$ 251.9 kJ b) 241.9 kJ c) $-$ 241.9 kJ d) 251.9 kJ

57. An ideal gas expands in volume from $1 \times 10^3 m^3$ to $1 \times 10^{-2} m^3$ at 300 K against a constant pressure of $1 \times 10^5 Nm^{-2}$. The work done is
a) 270 kJ b) $-900$ kJ c) $-900$ J d) 900 kJ

58. For the reaction $3O_2 \longrightarrow 2O_3$; $\Delta H = +$ve, we can say :
a) $O_3$ is more stable than $O_2$
b) $O_3$ is less stable than $O_2$
c) Both are equally stable
d) Formation of $O_3$ is exothermic

59. One mole of a gas absorbs 200 J of heat at constant volume. Its temperature rises from 298K To 308K. The change in internal energy is:
a) 200 J b) $-200$ J c) $200 \times \frac{308}{298}$ J d) $200 \times \frac{298}{308}$ J

60. Which of the following have same units?
(i) work (ii) Heat
(iii) Energy (iv) Entropy
a) (i), (ii) and (iii) b) (i), (ii) and (iv) c) (ii), (iii) and (iv) d) (iii) and (iv)

61. For an ideal gas, the relation between the enthalpy change and internal energy change at constant temperature is given by :
a) $H = U + PV$ b) $\Delta H = \Delta U + \Delta nRT$ c) $\Delta U = \Delta H + P\Delta V$ d) $\Delta H = \Delta G + T\Delta S$

62. Vibrational energy is:
a) Partially potential and partially kinetic b) Only potential c) Only kinetic d) None of the above

63. The relation $\Delta G = \Delta H - T\Delta S$ was given by

a) Boltzmann b) Faraday c) Gibbs-Helmholtz d) Thomson

64. Calculate the free energy change of

$2CuO(s) \rightarrow Cu_2O(s) + \frac{1}{2}O_2(g)$

Given, $\Delta H = 145.6$kJ per mol

$\Delta S = 116$ J per mol per K

a) 113.8 kJ per mol b) 221.5 kJ per mol c) 55.4 kJ per mol d) 145.6 kJ per mol

65. The bond dissociation energy of B—F in $BF_3$ is 646 kJ $mol^{-1}$, whereas that of C—F in $CF_4$ is 515 kJ $mol^{-1}$.

The correct reason for higher B—F bond dissociation energy as compared to that of C—F is :

a) Stronger σ bond between B and F in $BF_3$ as compared to that between C and F in $CF_4$

b) Significant $p\pi - p\pi$ interaction between B and F in $BF_3$ whereas there is no possibility of such interaction between C and F in $CF_4$

c) Lower degree of $p\pi - p\pi$ interaction between B and F in $BF_3$ than that between C and F in $CF_4$

d) Smaller size of B-atom as compared to that of C-atom

66. When water is added to quick lime, the reaction is :

a) Explosive b) Endothermic c) Exothermic d) None of these

67. An engine operating between 150°C and 25°C takes 500 J heat from a higher temperature reservoir if there are no frictional losses, then work done by engine is

a) 165.85 J b) 169.95 J c) 157.75 J d) 147.7 J

68. Least random state of water is:

a) Ice

b) Liquid water

c) Steam

d) All present in same random state

69. Given that standard heat enthalpy of $CH_4, C_2H_4$ and $C_3H_8$ are $-17.9, 12.5, -24.8$ kcal/mol. The $\Delta H$ for $CH_4 + C_2H_4 \rightarrow C_3H_8$ is :

a) $-55.2$ kcal $mol^{-1}$ b) $-30.2$ kcal $mol^{-1}$ c) $55.2$ kcal $mol^{-1}$ d) $-19.4$ kcal $mol^{-1}$

70. Absorption of gasses on solid surface is generally exothermic because

a) Enthalpy is positive

b) Entropy decreases

c) Entropy increases

d) Free energy increases

71. Energy equivalent to one erg, one joule and one calorie are in order:

a) 1 erg > 1 J > 1 cal b) 1 erg > 1 cal > 1 J c) 1 cal > 1 J > 1 erg d) 1 J > 1 cal > 1 erg

72. When the change of entropy is greater, then the ability for work is:

a) Maximum b) Minimum c) Medium d) None of these

73. For which change $\Delta H \neq \Delta U$?

a) $H_2 + I_2 \rightleftharpoons 2HI$

b) $HCl + NaOH \rightarrow NaCl + H_2O$

c) $C(s) + O_2(g) \rightleftharpoons CO_2(g)$

d) $N_2 + 3H_2 \rightarrow 2NH_3$

74. Net work done by a system is given by:

a) Decrease in Helmholtz energy ($\Delta A$)

b) Decrease in Gibbs energy ($\Delta G$)

c) Decrease in internal energy

d) Decrease in heat enthalpy

75. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below :

$$\frac{1}{2}Cl_2(g) \xrightarrow{\frac{1}{2}\Delta_{diss}H^{\ominus}} Cl(g) \xrightarrow{\Delta_{eg}H^{\ominus}} Cl^-(g) \xrightarrow{\Delta_{hyd}H^{\ominus}} Cl^-(aq)$$

The energy involved in the conversion of

$\frac{1}{2}Cl_2$ (g) to $Cl^-(aq)$

(using the data, $\Delta_{diss}H^{\ominus}_{Cl_2} = 240$ kJ mol$^{-1}$, $\Delta_{eg}H^{\ominus}_{Cl} = -349$ kJ mol$^{-1}$, $\Delta_{hyd}H^{\ominus}_{Cl^-} = -381$ kJ mol$^{-1}$) will be :

a) $+120$ kJ mol$^{-1}$ b) $+152$ kJ mol$^{-1}$ c) $-610$ kJ mol$^{-1}$ d) $-850$ kJ mol$^{-1}$

76. The law of Lavoisier and Laplace is based on :
    a) The principle of conservation of energy
    b) Equivalence of mechanical and thermal energies
    c) The principle of conservation of matter
    d) Equivalence of mechanical and chemical energies
77. $\Delta H$ for the reaction given below represents,
    $CO_2$ (g) + $H_2$(g) ⟶ CO(g) + $H_2O$(g); $\Delta H = 40$ kJ:
    a) Heat of formation b) Heat of combustion c) Heat of neutralisation d) Heat of reaction
78. A person requires 2870 kcal of energy to lead normal daily life. If heat of combustion of cane sugar is $-1349$ kcal, then his daily consumption of sugar is:
    a) 728 g b) 0.728 g c) 342 g d) 0.342 g
79. The enthalpy of hydrogenation of cyclohexene is $-119.5$ kJ mol$^{-1}$. If resonance energy of benzene is $-150.4$ kJ mol$^{-1}$, its enthalpy of hydrogenation would be:
    a) $-269.9$ kJ mol$^{-1}$ b) $-358.5$ kJ mol$^{-1}$ c) $-508.9$ kJ mol$^{-1}$ d) $-208.1$ kJ mol$^{-1}$
80. The incorrect expression among the following is:
    In isothermal process
    a) $W_{reversible} = -nRT\ln\frac{V_f}{V_i}$ b) $\ln K = \frac{\Delta H^{\circ} - T\Delta S^{\circ}}{RT}$ c) $K = e^{-\Delta G^{\circ}/RT}$ d) $\frac{\Delta G_{system}}{\Delta S_{total}} = -T$
81. An ideal gas expands in volume from $1 \times 10^{-3}$ m$^3$ to $1 \times 10^{-2}$ m$^3$ at 300 K against a constant pressure of $1 \times 10^5$ Nm$^{-2}$. The work done is
    a) -900 J b) -900 kJ c) 270 kJ d) 900 kJ
82. $C + O_2 \rightarrow CO_2$;
    $CO + \frac{1}{2}O_2 \rightarrow CO_2$
    Then the heat of formation of CO is
    a) $X - Y$ b) $Y - 2X$ c) $X + Y$ d) $2X - Y$
83. The formation water from $H_2$(g) and $O_2$(g) is an exothermic reaction because :
    a) The chemical energy of $H_2$(g) and $O_2$(g) is more than that of water
    b) The chemical energy of $H_2$(g) and $O_2$(g) is less than that of water
    c) Not dependent on energy
    d) The temperature of $H_2$(g) and $O_2$(g) is more than that of water
84. Which statements are correct?
    a) $2.303\log\frac{P_2}{P_1} = \frac{\Delta H_{vap.}}{R}\frac{[T_2 - T_1]}{T_1T_2}$ is Clausius Clapeyron equation
    b) $\frac{\Delta H_{vap.}}{\text{Boiling point}} = 88$J mol$^{-1}$K$^{-1}$ is called Trouton's rule
    c) Entropy is a measure of unavailable energy, *i. e.*, unavailable energy = entropy × temperature
    d) All of the above
85. The work done in an open vessel at 300 K, when 112 g iron reacts with dil. HCl is:
    a) 102 kcal b) 0.6 kcal c) 0.3 kcal d) 0.2 kcal
86. A solution of 500 mL of 2*M* KOH is added to 500 mL of 2*M* HCl and the mixture is well shaken. The rise in temperature $T_1$ is noted. The experiment is then repeated using 250 mL of each solution and rise in

temperature $T_2$ is again noted. Assume all heat is taken up by the solution:

a) $T_1 = T_2$

b) $T_1$ is 2 time as larger as $T_2$

c) $T_2$ is twice larger as $T_1$

d) $T_1$ is 4 time as larger as $T_2$

87. When 1 mole 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?

a) $q = -W = 500\ \text{J}, \Delta U = 0$

b) $q = \Delta U = 500\ \text{J}, W = 0$

c) $q = W = 500\ \text{J}, \Delta U = 0$

d) $\Delta U = 0, q = W = -500\ \text{J}$

88. The heat of formation is the change in enthalpy accompanying the formation of a substance from its elements at 298 K and 1 atm pressure. Since, the enthalpies of elements in their most stable state are taken to be zero, the heat of formation of compounds is :

a) Always negative

b) Always positive

c) Standard heat enthalpy of that compound

d) Zero

89. If enthalpies of methane and ethane are respectively 320 and 360 cal then the bond energy of C − C bond is

a) 80 cal b) 40 cal c) 60 cal d) 120 cal

90. Which correctly represents the physical significance of Gibbs energy change?

a) $-\Delta G = W_{\text{compression}}$

b) $\Delta G = W_{\text{expansion}}$

c) $\Delta G = -W_{\text{expansion}} = W_{\text{non-expansion}}$

d) $-\Delta G = W_{\text{expansion}}$

91. Heat of neutralisation of which acid-base reaction is − 57.32 kJ for?

a) $CH_3COOH + NaOH$ b) $HCl + NH_4OH$ c) $HCOOH + KOH$ d) $HNO_3 + LiOH$

92. Entropy change of vaporisation at constant pressure is given by:

a) $\Delta S_{(v)} = \frac{\Delta H_v}{T}$ b) $\Delta S_v = \frac{\Delta U_v}{T}$ c) $\Delta S_{(v)} = \frac{\Delta H_v}{\Delta T}$ d) None of these

93. Given, $C + O_2 \rightarrow CO_2 + 94.2$ kcal ….(i)

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O + 68.3$ kcal ….(ii)

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + 210.8$ kcal ….(iii)

The heat of formation in kcal will be :

a) 45.9

b) 47.8

c) − 20.0

d) 47.3

94. The enthalpy of formation of HI is 30.4 kJ. Which statement is false according to this observation?

a) HI is an endothermic compound

b) For the reaction, $H_2(g) + I_2(g) \longrightarrow 2HI(g);\ \Delta H = 60.8$ kJ

c) HI is a stable compound

d) HI is an unstable compound

95. Mark the correct statement

a) For a chemical reaction to be feasible, $\Delta G$ should be zero

b) Entropy is a measure of order in a system

c) For a chemical reaction to be feasible, $\Delta G$ should be positive

d) The total energy of an isolated system is constant

96. The entropy change for vaporisation of liquid water to steam at 100°C is...J $K^{-1}mol^{-1}$. Given that heat of vaporisation is 40.8 kJ $mol^{-1}$.
a) 109.38 b) 100.38 c) 110.38 d) 120.38

97. Given the bond energies of N ≡ N, H—H and N—H bonds as 945, 436 and 39 kJ $mol^{-1}$ respectively, the enthalpy of the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is :
a) − 93 kJ b) 102 kJ c) 90 kJ d) 105 kJ

98. When ammonium chloride is dissolved in water, the solution becomes cold. The change is:
a) Endothermic b) Exothermic c) Super cooling d) None of these

99. The Gibbs energy change and standard Gibbs energy change are equal if reaction quotient is equal to:
a) Zero b) 1 c) $> 1$ d) $< 1$

100. The bond energy of $H_2$ is 104.3 kcal $mol^{-1}$. It means : ($N$ = Av. no.)
a) 104.3 kcal heat is required to break up $N$ bonds in $N$ molecules of $H_2$
b) 104.3 kcal heat is required to break up $N$ molecules to $2N$ atoms of H
c) 104.3 kcal heat is evolved during combination of $2N$ atoms of H to from $N$ molecules of $H_2$
d) Heat of formation of H atom $= \frac{1}{2} \times$ bond energy of H— H

101. For the process, $CO_2(s) \longrightarrow CO_2(g)$:
a) Both $\Delta H$ and $\Delta S$ are +ve
b) $\Delta H$ is −ve and $\Delta S$ is +ve
c) $\Delta H$ is +ve and $\Delta S$ is −ve
d) Both $\Delta H$ and $\Delta S$ are −ve

102. The process, in which no heat enters or leaves the system is termed as
a) Isochoric b) Isobaric c) Isothermal d) Adiabatic

103. 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
a) -6 J b) -608 J c) +304 J d) -304 J

104. Which are correct to express work terms?
a) Work = Capacity factor × Intensity factor; where capacity factor is a measure of extent of work done and intensity factor is a measure of force responsible for work
b) Electrical work = $E \times nF$; $E$ is intensity factor; $nF$ is capacity factor
c) Expansion work = $P \times \Delta V$; $P$ is intensity factor; $\Delta V$ is capacity factor
d) All of the above

105. Theenthalpy change for the transition of liquid water to steam is $\Delta H_{vap} = 37.3$ kJ $mol^{-1}$ at 373 K. The entropy change for the process is
a) 132.5 J $mol^{-1}K^{-1}$ b) 100 J $mol^{-1}K^{-1}$ c) 135.3 J $mol^{-1}K^{-1}$ d) 75.5 J $mol^{-1}K^{-1}$

106. Which is not a spontaneous process?
a) Expansion of a gas into vacuum
b) Water flowing down hill
c) Heat flowing from colder body to a hotter body
d) Evaporation of water from clothes during drying

107. In a chemical reaction $\Delta H = 150$ kJ and $\Delta S = 100$ $JK^{-1}$ at 300 K. The $\Delta G$ for the reaction is:
a) Zero b) 300 kJ c) 330 kJ d) 120 kJ

108. Enthalpy of $CH_4 + \frac{1}{2}O_2 \rightarrow CH_3OH$ is negative. If enthalpy of combustion of $CH_4$ and $CH_3OH$ are $x$ and $y$ respectively. Then which relation is correct?
a) $x > y$ b) $x < y$ c) $x = y$ d) $x \geq y$

109. The enthalpy and entropy change for the reaction,
$Br_2(l) + Cl_2(g) \rightarrow 2BrCl(g)$

Are 30 kJ $mol^{-1}$ and 105 $JK^{-1}mol^{-1}$ respectively. The temperature at which the reaction will be in equilibrium is:

a) 450 K b) 300 K c) 285.7 K d) 273 K

110. The gas in a refrigerator causes cooling on expansion because:
   a) Work done by the gas is converted into heat
   b) Heat of the gas is lost as work is done by the gas
   c) The heat is spread over a large space
   d) None of the above
111. $\Delta S$ is positive for the change:
   a) Mixing of two gases b) Boiling of liquid c) Melting of solid d) All of these
112. In a flask, colourless $N_2O_4(g)$ is in equilibrium with brown coloured $NO_2(g)$. At equilibrium when the flask is heated to 100°C, the brown colour deepens and on cooling it becomes coloured. Which statement is incorrect about this observation?
   a) The $\Delta H$ for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ is +ve
   b) Paramagnetism increases on cooling
   c) The $\Delta H - \Delta U$ at 100°C is equal to 200 cal
   d) Dimerisation is reduced on heating
113. A gaseous reaction was carried out, first keeping the volume constant and next keeping the pressure constant. In the second experiment, there was an increase in volume. The heats of reaction were different, because :
   a) In the first case the energy was spent to keep the volume constant
   b) In the second case energy was spent to expand the gases
   c) Specific heats of compressed gases is more
   d) Specific heats of rarefied gases is more
114. The maximum work done in expanding 16 g oxygen at 300 K and occupying a volume of 5 $dm^3$ isothermally until the volume become 25$dm^3$ is:
   a) $2.01 \times 10^3$ J b) $+2.81 \times 10^3$ J c) $2.01 \times 10^{-3}$ J d) $+2.01 \times 10^{-6}$ J
115. The heat of neutralization of strong base and a strong acid is 57 kJ. The heat released when 0.5 mole of $HNO_3$ solution is added to 0.20 mole of NaOH solution, is :
   a) 11.4 kJ b) 34.7 kJ c) 23.5 kJ d) 58.8 kJ
116. For which one of the following equations is $\Delta H^{\circ}_{\text{reaction}}$ equal to $\Delta H^{\circ}_f$ for the product?
   a) $N_2(g) + O_3(g) \longrightarrow N_2O_3(g)$
   b) $CH_4(g) + 2Cl_2(g) \longrightarrow CH_2Cl_2(l) + 2HCl(g)$
   c) $Xe(g) + 2F_2(g) \longrightarrow XeF_4(g)$
   d) $2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$
117. If a chemical change is brought about by one or more methods in one or more steps, then the amount of heat absorbed or evolved during the complete course of reaction is same, whichever method was followed. This law is known as :
   a) Le-Chatelier's principle
   b) Hess's law
   c) Joule-Thomson effect
   d) Trouton's law
118. When a gas undergoes adiabatic expansion, it gets cooled due to
   a) Loss of kinetic energy b) Fall in temperature
   c) Decrease in velocity d) Energy used in doing work
119. How much heat (in kJ) is evolved when 2.7 g of aluminium reacts with a stoichiometric amount of $Fe_2O_3$?
   $2Al_2 + Fe_2O_3 \rightarrow 2Fe + Al_2O_3;\ \Delta H^o = -852$ kJ
   a) 852 kJ b) 426 kJ c) −42.6 kJ d) +42.6 kJ
120. Which reaction is endothermic in nature?

a) $CaCO_3 \rightarrow CaO + CO_2$
b) $C + O_2 \rightarrow CO_2$
c) $NaOH + HCl \rightarrow NaCl + H_2O$
d) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

121. The enthalpy and entropy change for a chemical reaction are $-2.5 \times 10^3$cal and 7.4 cal $K^{-1}$ respectively. Predict that nature of reaction at 298 K is:
a) Spontaneous b) Reversible c) Irreversible d) Non-spontaneous

122. If 50 calorie are added to a system and system does work of 30 calorie on surroundings, the change in internal energy of system is:
a) 20 cal b) 50 cal c) 40 cal d) 30 cal

123. If a refrigerator's door is opened then, we get
a) Room heated
b) Room cooled
c) More amount of heat is passed out
d) No effect on room

124. When a bottle of perfume is opened, odourous molecules mix with air and slowly diffuse throughout the entire room. The incorrect fact about the process is;
a) $\Delta G = -ve$ b) $\Delta H \simeq 0$ c) $\Delta S = -ve$ d) $\Delta S = +ve$

125. Equilibrium constant of a reaction is related to:
a) Standard Gibbs energy change $\Delta G°$
b) Gibbs energy change $\Delta G$
c) Heat enthalpy
d) None of the above

126. 48 g of C (diamond) on complete combustion evolves 1584 kJ of heat. The standard heat of formation of gaseous carbon is 725 kJ/mol. The energies required for the process
(i)C (graphite) → C(gas)
(ii)C (diamond) → C(gas)are:
a) 725, 727 b) 717, 725 c) 725, 723 d) None of these

127. An example of closed system is:
a) Hot water present in an open beaker
b) Some amount of water present in equilibrium with its vapour in a closed and insulated beaker
c) Some amount of hot water enclosed in a closed container which is not insulated
d) None of the above

128. At 1 atm pressure, $\Delta S = 75$ $JK^{-1}mol^{-1}$; $\Delta H = 30$ kJ $mol^{-1}$. The temperature of the reaction at equilibrium is:
a) 400 K b) 330 K c) 200 K d) 110 K

129. 2.1 g of Fe combines with S evolving 3.77 kJ. The heat of formation of FeS in kJ/mole is
a) $-1.79$ b) $-100.5$ c) $-3.77$ d) None of these

130. In an isochoric process, the increase in internal energy is
a) Equal to the heat absorbed
b) Equal to the heat evolved
c) Equal to the work done
d) Equal to the sum of the heat adsorbed and work done

131. The sublimation energy of $I_2(s)$ is 57.3 kJ/mol and the enthalpy of fusion is 15.5 kJ/mol. The enthalpy of vaporisation of $I_2$ is
a) 41.8 kJ/mol b) -41.8 kJ/mol c) 72.8 kJ/mol d) -72.8 kJ/mol

132. $\Delta G°$for the reaction $X + Y \rightleftharpoons Z$ is $-4.606$ kcal. The value of equilibrium constant of the reaction at 227°C is ($R = 2.0$ cal $mol^{-1}K^{-1}$)
a) 100 b) 10 c) 2 d) 0.01

133. The entropy values (in $JK^{-1}$ $mol^{-1}$) of $H_2(g) = 130.6$ $Cl_2(g) = 223.0$ and $HCl(g) = 186.7$ J $mol^{-1}K^{-1}$ at 298 K and 1 atm pressure, the entropy change for the reaction $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ is

a) +540.3 b) +727.3 c) −166.9 d) +19.8

134. Bond energy of molecule:
   a) Is always negative
   b) Is always positive
   c) Either positive or negative
   d) Depends upon the physical state of the system

135. In which case of mixing of a strong acid and a base each of $1N$ concentration, temperature increase is highest?
   a) 20 mL acid − 20mL alkali
   b) 10 mL acid − 40mL alkali
   c) 25 mL acid − 25mL alkali
   d) 35 mL acid − 15mL alkali

136. $\Delta S^o$ will be highest for the reaction
   a) $Ca(s) + \frac{1}{2}O_2(g) \rightarrow CaO(s)$ b) $CaCO_3(g) \rightarrow CaO(s) + CO_2(g)$
   c) $C(g) + O_2(g) \rightarrow CO_2(g)$ d) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

137. Bond dissociation enthalpy of $H_2, Cl_2$ and HCl are 434, 242 and 431 kJ $mol^{-1}$ respectively. Enthalpy of formation of HCl is :
   a) − 245 kJ $mol^{-1}$ b) − 93 kJ $mol^{-1}$ c) 245 kJ $mol^{-1}$ d) 93 kJ $mol^{-1}$

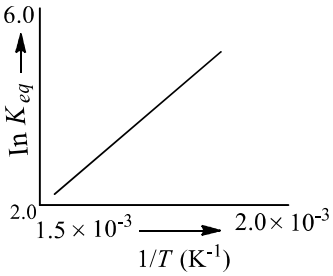
138. Joule-Thomson expansion is
   a) Isobaric b) Isoenthalpic c) Isothermal d) None of these

139. The energy absorbed by each molecule $(A_2)$ of a substance is $4.4 \times 10^{-19}$ J and bond energy per molecule is $4.0 \times 10^{-19}$ J. The kinetic energy of the molecule per atom will be :
   a) $4.0 \times 10^{-20}$ J b) $2.0 \times 10^{-20}$ J c) $2.2 \times 10^{-19}$ J d) $2.0 \times 10^{-19}$ J

140. Which one of the following is not a state function?
   a) Enthalpy b) Entropy c) Work d) Free energy

141. Temperature and heat are:
   a) Extensive properties
   b) Intensive properties
   c) Intensive and extensive properties respectively
   d) Extensive and intensive properties respectively

142. A schematic plot of In $K_{eq}$ *versus* inverse of temperature for a reaction is shown below




   The reaction must be
   a) Exothermic b) Endothermic
   c) One with negligible enthalpy change d) Highly spontaneous at ordinary temperature

143. For a reaction at 25°C, enthalpy and entropy changes are $-11.7 \times 10^3$ J $mol^{-1}$ and $-105$ J $mol^{-1}K^{-1}$ respectively. What is the Gibbs free energy?
   a) 15.05 kJ b) 19.59 kJ c) 2.55 kJ d) 22.55 kJ

144. Which of the following equations correctly represents the standard heat of formation $(\Delta H_f^o)$ of methane?
   a) $C(diamond) + 2H_2(g) \rightarrow CH_4(g)$ b) $C(graphite) + 2H_2(g) \rightarrow CH_4(l)$
   c) $C(graphite) + 2H(g) \rightarrow CH_4(g)$ d) $C(graphite) + 4H \rightarrow CH_4(g)$

145. Combustion of glucose takes place according to the equation
$C_6H_{12}O_6 + CO_2 \rightarrow 6CO_2 + 6H_2O; \Delta H = -72$kcal. How much energy will be required for the production of 1.6 g of glucose (Molecular mass of glucose = 180)?
a) 0.064 kcal b) 0.64 kcal c) 6.4 kcal d) 64 kcal

146. In an irreversible process taking place at constant $T$ and $P$ and in which only pressure volume work is being done, the change in Gibbs free energy $(dG)$ and change in entropy
a) $(dS)_{V,E} < 0 (dG)_{T,P} < 0$ b) $(dS)_{V,E} > 0 (dG)_{T,P} < 0$
c) $(dS)_{V,E} > 0 (dG)_{T,P} = 0$ d) $(dS)_{V,E} = 0 (dG)_{T,P} > 0$

147. Hess's law states that
a) The standard enthalpy of an overall reaction is the sum of the enthalpy changes in individual reactions.
b) Enthalpy of formation of a compound is same as the enthalpy of decomposition of the compound into constituent elements, but with opposite sign.
c) At constant temperature the pressure of a gas is inversely proportional to its volume.
d) The mass of a gas dissolved per litre of a solvent is proportional to the pressure of the gas in equilibrium with the solution.

148. Internal energy is sum of
a) Kinetic energy and potential energy b) All types of energy of the system
c) Energy of internal system d) None of the above

149. Heat given to a system under isochoric process is equal to:
a) $W$ b) $q_p$ c) $\Delta U$ d) $\Delta H$

150. All the naturally occurring processes, *i. e.*, spontaneous proceed spontaneously in a direction which leads to:
a) Decrease of free energy
b) Increase of free energy
c) Decrease of entropy
d) Increase of enthalpy

151. Which phenomena cannot be described as oxidation?
a) Oxidation of coal in air
b) Burning of magnesium in nitrogen
c) Reaction of antimony with chlorine
d) Lighting of an electric lamp

152. Heat of formation of $H_2O$ is $-188$ kJ/mol and $H_2O_2$ is $-286$ kJ/mol. The enthalpy change for the reaction $2H_2O_2 \rightarrow 2H_2O + O_2$ is
a) 196 kJ b) $-196$ kJ c) 984 kJ d) $-984$ kJ

153. When 1g atom of carbon is converted into 1g molecule of $CO_2$, the heat liberated is same:
a) Irrespective of whether the volume is kept constant or pressure is kept constant
b) Irrespective of the temperature at which the reaction is carried out
c) Whether the carbon is in the form of diamond or graphite
d) None of the above

154. For the gas phase reaction,
$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
Which of the following conditions are correct?
a) $\Delta H > 0$ and $\Delta S > 0$ b) $\Delta H < 0$ and $\Delta S < 0$ c) $\Delta H > 0$ and $\Delta S < 0$ d) $\Delta H = 0$ and $\Delta S < 0$

155. A system provided 50 joule of heat and work done on the system is 10 J. The change in internal energy during the process is:
a) 40 J b) 60 J c) 80 J d) 50 J

156. The correct relationship between free energy change in a reaction and the corresponding equilibrium

constant $K_c$ is

a) $\Delta G = RT\ \mathrm{In}K_c$ b) $-\Delta G = RT\ \mathrm{In}K_c$ c) $\Delta G° = RT\ \mathrm{In}K_c$ d) $-\Delta G° = RT\ \mathrm{In}K_c$

157. Identify the correct statement for change of Gibb's energy for a system ($\Delta G_{\text{system}}$) at constant temperature and pressure:
   a) If $\Delta G_{\text{system}} = 0$, the system is still moving in a particular direction
   b) If $\Delta G_{\text{system}} = -$ve, the process is not spontaneous
   c) If $\Delta G_{\text{system}} = +$ve, the process is spontaneous
   d) If $\Delta G_{\text{system}} = 0$, the system has attained equilibrium
158. The standard heat of combustion of solid boron is :
   a) $\Delta_f H°(B_2O_3)$ b) $\frac{1}{2}\Delta_f \Delta H°(B_2O_3)$ c) $-\Delta_f H^0\ (B_2O_3)$ d) $-\frac{1}{2}\Delta_f \Delta H°(B_2O_3)$
159. During an isothermal expansion of an ideal gas its:
   a) Enthalpy decreases
   b) Internal energy decreases
   c) Internal energy increases
   d) Internal energy remains constant
160. The exchange of heat energy during chemical reaction at constant temperature and pressure occurs in form of:
   a) Free energy b) Internal energy c) Enthalpy d) Bond energy
161. Using the data provided, calculate the multiple bond energy (kJ $mol^{-1}$) of a C ≡ C bond in $C_2H_2$. Given that the heat of formation of $C_2H_2$ is 225 kJ $mol^{-1}$ (take the bond energy of C—H bond as 350 kJ $mol^{-1}$.) :
   $2C(s) \rightarrow 2C(g)$ $\Delta H = 1410$ kJ $mol^{-1}$
   $2C(s) \rightarrow 2C(g)$ $\Delta H = 1410$ kJ $mol^{-1}$
   $H_2(g) \rightarrow 2H(g)$ $\Delta H = 330$ kJ $mol^{-1}$
   a) 1165 b) 837 c) 865 d) 815
162. The molar heat capacity of water at constant pressure is 75 $JK^{-1}$ $mol^{-1}$. When 1.0 kJ of heat is supplied to 100 g of water which is free to expand the increase in temperature of water is
   a) 2.4 K b) 3.6 K c) 4.8 K d) 1.2 K
163. For which of the process, $\Delta S$ is negative?
   a) $H_2(g) \rightarrow 2H(g)$ b) $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$
   c) $N_2(1\text{ g atom}) \rightarrow N_2(8\text{ g atom})$ d) $C_{(\text{diamond})} \rightarrow C_{(\text{graphite})}$
164. Given that, $C(g) + 4H(g) \rightarrow CH_4(g);\ \Delta H = -166$ kJ. The bond energy C − H will be
   a) −416 kJ/mol b) −41.6 kJ/mol c) 832 kJ/mol d) None of these
165. In an isobaric process, the ratio of heat supplied to the system ($d\theta$) and work done by the system ($dW$) for diatomic gas is
   a) 1:1 b) 7:2 c) 7:5 d) 5:7
166. An adiabatic process occurs in
   a) Open system b) Closed system
   c) Isolated system d) In all the given system
167. The heat of formation of water is exothermic in nature because :
   a) $H_2(g)$ and $O_2(g)$ have higher temperature than water
   b) $H_2(g)$ and $O_2(g)$ have lower temperature than water
   c) $H_2(g)$ and $O_2(g)$ have higher internal energy than water
   d) None of the above
168. In an adiabatic process
   a) $p.\Delta V = 0$ b) $q = +W$ c) $\Delta E = q$ d) $q = 0$
169. A well stoppered thermos flask containing some ice cubes is an example of:
   a) Closed system b) Open system c) Isolated system d) None of these

170. Internal energy is
    a) Partly potential and partly kinetic
    b) Totally kinetic
    c) Totally potential
    d) None of the above

171. The enthalpy of formation of ammonia gas at 298 K is $-46.11$ kJ $mol^{-1}$. The equation to which this value relates is:
    a) $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \longrightarrow NH_3(g)$
    b) $N(g) + 3H(g) \longrightarrow NH_3(g)$
    c) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$
    d) $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \longrightarrow NH_3(l)$

172. $C_{diamond} + O_2 \rightarrow CO_2;\ \Delta H = -395.3$ kJ/mol
    $C_{graphite} + O_2 \rightarrow CO_2;\ \Delta H = -393.4$ kJ/mol
    $C_{graphite} \rightarrow C_{diamond};\ \Delta H = ?$
    a) $-3.8$ b) $-1.9$ c) $+3.8$ d) $+1.9$

173. The heat evolved in the combustion of methane is given by the following equations
    $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + H_2O(l);\ \Delta H = -890.3$ kJ
    How many grams of methane would be required to produce 44.15 kJ of heat of combustion?
    a) 4 g b) 8 g c) 12 g d) 16 g

174. The calorific value of fat is :
    a) Lesser than that of carbohydrate and protein
    b) Lesser than that of protein but more than carbohydrates
    c) Lesser than that of carbohydrate but more than protein
    d) More than that of carbohydrate and protein

175. The standard heat of formation of $NO_2(g)$ and $N_2O_4(g)$ are 8.0 and 2.0 kcal $mol^{-1}$ respectively. The heat of dimerization of $NO_2$ in kcal is :
    a) 10.0 b) $-6.0$ c) $-12.0$ d) $-14.0$

176. Given that,
    $3C(s) + 2Fe_2O_3(s) \rightarrow 4Fe(s) + 3CO_2(g) \Delta H^o = -93657$ cal
    $C(s) + O_2(g) \rightarrow CO_2(g);\ \Delta H^o = -94050$ cal
    If both the values of $\Delta H$ are at 25°C then calculate $\Delta H^o_{Fe_2O_3}$
    a) 16.750 kcal b) $-16.750$ kcal c) $-94.25$ kcal d) $-393$ kcal

177. 16 g oxygen gas expands at STP to occupy double of its original volume. The work done during the process is:
    a) 260 kcal b) 180 kcal c) 130 kcal d) 272.8 kcal

178. One mole of an ideal gas at 300K is expanded isothermally from an initial volume of 1 litre to 10 litre. The $\Delta U$ for this process is ($R = 2$ cal $K^{-1}mol^{-1}$):
    a) 163.7 cal b) 1381.1 cal c) 1.0 J $mol^{-1}K^{-1}$ d) 0.1 J $mol^{-1}K^{-1}$

179. Gibbs energy $G$, enthalpy $H$ and entropy $S$ are related by:
    a) $G = H + TS$ b) $G = H - TS$ c) $G - TS = H$ d) $S = H - G$

180. In a closed insulated container a liquid is stirred with a paddle to increase the temperature, which of the following is true?
    a) $\Delta U + W \neq 0, q = 0$ b) $\Delta U = W = q \neq 0$ c) $\Delta U = 0, W = q \neq 0$ d) $W = 0, \Delta U = q \neq 0$

181. The ionization energy of solid NaCl is 180 kcal per mole. The dissolution of the solid in water in the form of ions is endothermic to the extent of 1 kcal per mol. If the solvation energies of $Na^+$ and $Cl^-$ ions are in the ratio 6:5, what is the enthalpy of hydration of sodium ion?
    a) $-85.6$ kcal/mol b) $-97.5$ kcal/mol c) 82.6 kcal/mol d) $+100$ kcal/mol

182. Enthalpy of solution of NaOH (solid) in water is $-41.6$ kJ $mol^{-1}$, when NaOH is dissolved in water, the temperature of water

a) Increases b) Decreases
c) Does not change d) Fluctuates indefinitely

183. Mark out the enthalpy of formation of carbon monoxide (CO)
Given, $C(s) + O_2(g) \rightarrow CO(g), \Delta H = -393.3$ kJ/mol
$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta H = -282.8$ kJ/mol
a) 110.5 kJ/mol b) 676.1 kJ/mol c) 282.8 kJ/mol d) 300.0 kJ/mol

184. Heat of neutralization of a strong acid and a strong base is equal to $\Delta H$ of :
a) $H^+ + OH^- = H_2O$
b) $H_2O + H^+ = H_3O^+$
c) $2H_2 + O_2 = 2H_2O$
d) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

185. The temperature of the system increases during an:
a) Isothermal expansion
b) Adiabatic compression
c) Adiabatic expansion
d) Isothermal compression

186. For an adiabatic expansion of a perfect gas $\Delta P/P$ is equal to:
a) $\Delta V/V$ b) $\gamma\frac{\Delta V}{V}$ c) $-\gamma\frac{\Delta V}{V}$ d) $-\gamma^2\frac{\Delta V}{V}$

187. The heat evolved during neutralisation is maximum in the reaction of :
a) $NH_4OH$ and $CH_3COOH$
b) $NH_4OH$ and HCl
c) NaOH and $CH_3COOH$
d) NaOH and HCl

188. In which reaction $\Delta S$ is positive?
a) $H_2O(l) \rightarrow H_2O(s)$
b) $3O_2(g) \rightarrow 2O_3(g)$
c) $H_2O(l) \rightarrow H_2O(g)$
d) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

189. It is impossible to attain the lowest temperature known as zero degree absolute. This is a simple statement of:
a) First law of thermodynamics
b) Second law of thermodynamics
c) Third law of thermodynamics
d) None of the above

190. The total entropy change for a system and its surroundings increases, if the process is:
a) Reversible b) Irreversible c) Exothermic d) Endothermic

191. Heat of formation of compound is defined as :
a) Heat evolved to form one mole of the compound from its elements
b) Heat required to form one molecule of a compound
c) Change in heat content of the system when one molecule of a compound is formed
d) None of the above

192. At absolute zero, the entropy of a perfect crystal is zero. This is … of thermodynamics.
a) First law b) Second law c) Third law d) None of these

193. Standard state Gibbs free energy changes for the isomerization reaction,
*cis*-2-pentene ⇌ *trans*-2-pentene is -3.67 kJ/mol at 400K. If more *trans*-2-pentene is added to the reaction vessel, then:
a) Equilibrium remains unaffected

b) Additional *trans*-2-pentene is formed
c) More *cis*-2-pentene is formed
d) Equilibrium is shifted in forward direction

194. If $S°$ for $H_2, Cl_2$ and HCl are $0.13, 0.22$ and $0.19 kJK^{-1}mol^{-1}$ respectively. The total change in standard entropy for the reaction, $H_2 + Cl_2 \rightarrow 2HCl$ is:
a) $30\ JK^{-1}mol^{-1}$ b) $40\ JK^{-1}mol^{-1}$ c) $60\ JK^{-1}mol^{-1}$ d) $20\ JK^{-1}mol^{-1}$

195. The total internal energy change for a reversible isothermal cycles is
a) Always 100 calories per degree
b) Always negative
c) Zero
d) Always positive

196. One mole of a gas occupying $3dm^3$ expands against constant external pressure of 1 atm to a volume of $13\ dm^3$. The work done is:
a) $-10\ atm\ dm^3$ b) $-20\ atm\ dm^3$ c) $-39\ atm\ dm^3$ d) $-48\ atm\ dm^3$

197. The heat of combustion of methane is $-880\ kJ\ mol^{-1}$. If 3.2 g of methan is burnt:
a) $-176$ kJ of heat is evolved
b) 176 $kJ$ of heat is absorbed
c) 88 $kJ$ of heat is evolved
d) None of above

198. Heat of solution is defined as :
a) Heat required to dissolved one mole in excess of water
b) Heat evolved, when one mole is dissolved in excess of water
c) Change in heat content of the system when one mole of the solute is dissolved un excess of water, so that further dilution of solution does not bring any heat change
d) None of the above

199. A mixture of two moles of carbon monoxide and one mole of oxygen, in a closed vessel is ignited to convert the carbon monoxide to carbon dioxide. If $\Delta H$ is the enthalpy change and $\Delta E$ is the change in internal energy, then
a) $\Delta H > \Delta E$
b) $\Delta H < \Delta E$
c) $\Delta H = \Delta E$
d) The relationship depends on the capacity of the vessel



200. Molar heat capacity is given by :
a) $\frac{dQ}{dT}$ b) $dQ \times dT$ c) $\Sigma Q \frac{1}{dT}$ d) None of these

201. Two mole of an ideal gas is expanded isothermally and reversibly from 1 L to 10 L at 300 K. The enthalpy change (in kJ) for the process is
a) 11.4 b) $-11.4$ c) 0 d) 4.8

202. A gaseous system changes from state $A(P_1, V_1, T_1)$ to $B(P_2, V_2, T_2)$, $B$ to $C(P_3, V_3, T_3)$ and finally from $C$ to $A$. The whole process may be called:
a) Reversible process b) Cyclic process c) Isobaric process d) Spontaneous process

203. One mole of ice is converted into water at 273 K. The entropies of $H_2O(s)$ and $H_2O(l)$ are 38.20 and $60.01\ J\ mol^{-1}K^{-1}$ respectively. The enthalpy change for the conversion is:
a) $59.54\ J\ mol^{-1}$ b) $5954\ J\ mol^{-1}$ c) $595.4\ J\ mol^{-1}$ d) $320.6\ J\ mol^{-1}$

204. For a diatomic molecule $AB$, the electronegativity difference between $A$ and $B = 0.2028\sqrt{\Delta}$. [Where $\Delta$= $b$ond energy of AB Geometric mean of the bond energies of $A_2$ and $B_2$] The electronegativities of fluorine and chlorine are 4.0 and 3.0 respectively and the bond energies are of $F - F$: 38 kcal $mol^{-1}$ and $Cl - Cl$ : 58 kcal $mol^{-1}$. The bond energy of $Cl - F$ is :
a) ~ 71 kcal/mol b) ~ 61 kcal/mol c) ~ 48 kcal/mol d) ~ 75 kcal/mol

205. Any series of operation so carried out that at the end, the system is back to its state is called
a) Boyle's cycle b) Reversible process c) Adiabatic process d) Cyclic process

206. The heat of neutralisation of a strong acid and a strong alkali is 57.0 kJ $mol^{-1}$. The heat released when 0.5 mole of $HNO_3$ solution is mixed with 0.2 mole of KOH is
a) 57.0 kJ b) 11.4 kJ c) 28.5 kJ d) 34.9 kJ

207. The Kirchhoff's equation gives the effect of .....on heat of reaction.
a) Pressure b) Temperature c) Volume d) Molecularity

208. $\Delta n$ values in $\Delta H = \Delta U + \Delta nRT$ may have:
a) Integer nature b) Fractional value c) Positive or negative d) All of these

209. $AB, A_2$ and $B_2$ are diatomic molecules. If the bond enthalpies of $A_2, AB$ and $B_2$ are in the ratio 1:1:0.5 and the enthalpy of formation of $AB$ from $A_2$ and $B_2$ is $-100$ kJ $mol^{-1}$, what is the bond enthalpy of $A_2$?
a) 400 kJ $mol^{-1}$ b) 200 kJ $mol^{-1}$ c) 100 kJ $mol^{-1}$ d) 300 kJ $mol^{-1}$

210. Which of the following is an intensive property?
a) Temperature b) Viscosity c) Surface tension d) All of these

211. The temperature of the system decreases in an
a) Adiabatic compression b) Isothermal compression
c) Isothermal expansion d) Adiabatic expansion

212. If a refrigerator door is kept open, then we get:
a) Room cooled
b) Room heated
c) More heat is passed out
d) No effect on room

213. The enthalpy of vaporization of a liquid is 30 kJ $mol^{-1}$ and entropy of vaporization is 75 J $mol^{-1}$. The boiling point of liquid at 1 atm is :
a) 250 K b) 400 K c) 450 K d) 600 K

214. Which is correct about the heat of combustion?
a) The combustion be exothermic in some cases and endothermic in other cases
b) Heat of combustion is always exothermic
c) Its value change with temperature
d) All of the above

215. In an isothermal process
a) $q = 0$ and $\Delta E = 0$ b) $q \neq 0$ and $\Delta E = 0$ c) $q = 0$ and $\Delta E \neq 0$ d) $q \neq 0$ and $\Delta E \neq 0$

216. The enthalpy of combustion of $H_2$, cyclohexane ($C_6H_{10}$) and cyclohexane ($C_6H_{12}$) are $-241, -3800$ and $-3920$ kJ per mol respectively. Heat of hydrogenation of cyclohexane is
a) 121 kJ/mol b) $-121$ kJ/mol c) $+242$ kJ/mol d) $-242$ kJ/mol

217. For the isothermal expansion of an ideal gas
a) $E$ and $H$ increases b) $E$ increases but $H$ decreases
c) $H$ increases but $E$ decreases d) $E$ and $H$ are unaltered

218. Heat evolved in the reaction, $H_2 + Cl_2 \rightarrow 2HCl$ is 182 kJ. Bond energies of H—H and Cl—Cl are 430 and 242 kJ/mol respectively. The H—Cl bond energy is :
a) 245 kJ $mol^{-1}$ b) 427 kJ $mol^{-1}$ c) 336 kJ $mol^{-1}$ d) 154 kJ $mol^{-1}$

219. Which is not correct?
a) In an exothermic reaction, the enthalpy of products is less than that of reactants
b) $\Delta H_{fusion} = \Delta H_{sublimation} - \Delta H_{vaporisation}$
c) A reaction for which $\Delta H^\circ < 0$ and $\Delta S^\circ > 0$ is possible at all temperatures
d) $\Delta H$ is less than $\Delta U$ for the reaction, $C(s) + (1/2)O_2\ (g) \rightarrow CO_2(g)$

220. A cylinder of gas is assumed to contain 11.2 kg of butane ($C_4H_{10}$). If a normal family needs 20000 kJ of energy per day. The cylinder will last (Given that $\Delta H$ for combustion of butane is $-2658$ kJ)
a) 20 days b) 25 days c) 26 days d) 24 days

221. The enthalpy of formation of water from hydrogen and oxygen is $-286$ kJ $mol^{-1}$. The enthalpy of

decomposition of water into hydrogen and oxygen is:

a) $-286$ kJ mol$^{-1}$ b) $-143$ kJ mol$^{-1}$ c) $+286$ kJ mol$^{-1}$ d) $+143$ kJ mol$^{-1}$

222. An ideal gas is allowed to expand both reversibly and irreversibly in an isolated system. If $T_i$ is the initial temperature and $T_f$ is the final temperature, which of the following statements is correct?

a) $(T_f)_{\text{irrev}} > (T_f)_{\text{rev}}$

b) $T_f > T_i$ for reversible process but $T_f = T_i$ for irreversible process

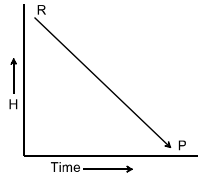
c) $(T_f)_{\text{rev}} = (T_f)_{\text{irrev}}$

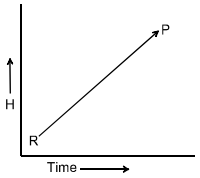
d) $T_f = T_i$ for both reversible and irreversible processes

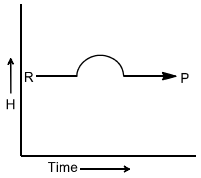
223. Heat of fusion of a molecular solid is :

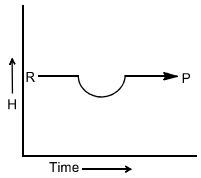
a) Very high b) High c) Low d) None of these

224. Which plot represents for an exothermic reaction?

a) 


b) 


c) 


d) 


225. For a spontaneous chemical change the Gibbs energy change is:

a) Positive

b) Negative

c) Zero

d) Depends whether the reaction is exothermic or endothermic

226. An ideal gas undergoing expansion in vacuum shows:

a) $\Delta U = 0$ b) $W = 0$ c) $q = 0$ d) All of these

227. Select the incorrect statement

a) $PV$ work is usually negligible for solid and liquid

b) For a closed system with $P - V$ work only, an isobaric process that has $q = +$ve must have $\Delta T = +$ve.

c) For a cyclic process $q = 0$

d) Black phosphorus is most stable form of $P$ but $H°_f = 0$ for white phosphorus.

228. Entropy decreases during:

a) Crystallization of sucrose from solution

b) Rusting of iron

c) Melting of ice

d) Vaporization of camphor

229. At 27°C latent heat of I fusion of a compound is 2930 J/mol. Entropy change during fusion is:

a) 9.77 J/mol K b) 10.77 J/mol K c) 9.07 J/mol K d) 0.977 J/mol K

230. The values of $\Delta H$ and $\Delta S$ for the reaction.

$C_{(\text{graphite})} + CO_2(g) \rightarrow 2CO(g)$

Are 170 kJ and 170 JK$^{-1}$ respectively. this reaction will be spontaneous at:

a) 510 K b) 710 K c) 910 K d) 1110 K

231. The temperature of 5 mL of a strong acid increases by 5°C when 5 mL of strong base is added to it. If 10 mL of each is mixed and complete neutralisation takes place then rise in temperature will be

a) 20°C b) 10°C c) 5°C d) 2°C

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

a) Higher than the initial temperature

b) Lower than the initial temperature

c) The same as the initial temperature

d) Dependent on the rate of compression

233. In a closed insulated container, a liquid is stirred with a paddle to increase its temperature. In this process,

which of the following is true

a) $\Delta E = W \neq 0, Q = 0$ b) $\Delta E \neq 0, Q = W = 0$

c) $\Delta E = W = Q = 0$ d) $\Delta E = 0, Q \neq 0, W = 0$

234. If the bond dissociation energies of $XY$, $X_2$ and $Y_2$ (all diatomic molecules) are in the ratio of 1: 1: 05 and $\Delta H$ for the formation of $XY$ is $-200$ kJ mol$^{-1}$. The bond dissociation energy of $X_2$ will be

a) 100 kJ mol$^{-1}$ b) 800 kJ mol$^{-1}$ c) 300 kJ mol$^{-1}$ d) 400 kJ mol$^{-1}$

235. The dissociation energy of $CH_4$ and $C_2H_6$ are respectively 360 and 620 kcal/mol. The bond energy of C $-$ C bond is:

a) 260 kcal/mol b) 180 kcal/mol c) 130 kcal/mol d) 80 kcal/mol

236. In a calorimeter, the temperature of the calorimeter increases by 6.12 K, the heat capacity of the system is 1.23 kJ/g deg. What is the molar heat of decomposition for $NH_4NO_3$?

a) $-7.53$ kJ/mol b) $-398.1$ kJ/mol c) $-16.1$ kJ/mol d) $-602$ kJ/mol

237. The bond energies of $F_2, Cl_2, Br_2$ and $I_2$ are 155.4, 243.6, 193.2 and 151.2 kJ mol$^{-1}$ respectively. The strongest bond is :

a) F $-$ F b) Cl $-$ Cl c) Br $-$ Br d) I $-$ I

238. The enthalpy changes of formation of the gaseous oxides of nitrogen ($N_2O$ and NO) are positive because of:

a) The high bond energy of the nitrogen molecule

b) The high electron affinity of oxygen atoms

c) The high electron affinity of nitrogen atoms

d) The tendency of oxygen to form $O^{2-}$

239. If 900 J/g of heat is exchanged at boiling point of water then increase in entropy

a) 43.4 J/mol b) 87.2 J/mol c) 900 J/mol d) Zero

240. A reaction occurs spontaneously if:

a) $T\Delta S = \Delta H$ and both $\Delta H$ and $\Delta S$ are positive

b) $T\Delta S > \Delta H$ and both $\Delta H$ and $\Delta S$ are positive

c) $T\Delta S < \Delta H$ and both $\Delta H$ and $\Delta S$ are positive

d) $T\Delta S > \Delta H$ and $\Delta H$ is positive and $\Delta S$ are negative

241. $H_2(g) + Cl(g) = 2HCl(g)$; $\Delta H(298\ K) = 22.06$ kcal. For this reaction, $\Delta U$ is equal to:

a) $-22.06 + 2 \times 10^{-3} \times 298 \times 2$ kcal

b) $-22.06 + 2 \times 298$ kcal

c) $-22.06 - 2 \times 298 \times 4$ kcal

d) $-22.06$ kcal

242. The heat change taking place during the reaction $H_2O(l) \rightarrow H_2O(g)$ is: [Given, $\Delta H_f$ of $H_2O(g) = -57$ kcal, $\Delta H_f = H_2O(l) = -68.3$ kcal]

a) + 11.3 kcal b) $-$ 11.3 kcal c) $-$ 115.3 kcal d) + 115.3 kcal

243. $\Delta H$ for $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ is 176 kJ mol$^{-1}$ at 1240 K. The $\Delta U$ for the change is equal to:

a) 160 kJ b) 165.6 kJ c) 186.3 kJ d) 180.0 kJ

244. When one mole of monoatomic ideal gas at $T$K undergoes adiabatic change under a constant external pressure of 1 atm changes volume from 1 L to 2 L. The final temperature in Kelvin would be

a) $\frac{T}{2^{2/3}}$ b) $T + \frac{2}{3 \times 0.0821}$ c) $T$ d) $T - \frac{2}{3 \times 0.0821}$

245. $\Delta H°$, (298 K)of methanol is given by the chemical equation

a) $CH_4(g) + \frac{1}{2}O_2(g) \rightarrow CH_3OH(g)$ b) $C(\text{graphite}) + \frac{1}{2}O_2(g) + 2H_2(g) \rightarrow CH_3OH(l)$

c) $C(\text{diamond}) + \frac{1}{2}O_2(g) \rightarrow CH_3OH(l)$ d) $CO(g) + 2H_2(g) \rightarrow CH_3OH(l)$

246. For the reaction, $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O$; $\Delta U = -1415$ kJ. Then $\Delta H$ at 27°C is :

a) $-1410$ kJ b) $-1420$ kJ c) + 1420 kJ d) +1410 KJ

247. The heat of combustion of ethanol determined by a bomb calorimeter is $-670.48$ kcal $mol^{-1}$ at 25°C. What is $\Delta U$ at 25°C for the following reaction?

$$C_2H_5OH(l) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$$

a) $-335.24$ kcal b) $-669.28$ kcal c) $-670.48$ kcal d) $+670.48$ kcal

248. Which has the least entropy?

a) Graphite b) Diamond c) $N_2(g)$ d) $N_2O(g)$

249. A carnot engine operates between temperature $T$ and 400 K ($T > 400$ K). If efficiency of engine is 25%, the temperature $T$ is:

a) 400 K b) 500 K c) 533.3 K d) 600 K

250. It is a general principle that if a system has the less energy then it is:

a) More stable b) Less stable c) Unstable d) More unstable

251. For the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, which is true?

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

252. $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$;

$\Delta H = -68.39$ kcal ..... (i)

$K + aq. \rightarrow KOH(aq) + \frac{1}{2}H_2$;

$\Delta H = -48$ kcal ..... (ii)

$KOH + aq. \rightarrow KOH(aq)$;

$\Delta H = -14$ kcal ..... (iii)

The heat of formation (in kcal) of KOH is :

a) $-68.39 + 48 - 14$

b) $-68.39 - 48 + 14$

c) $68.39 - 48 + 14$

d) $68.39 + 48 + 14$

253. Which of the following expressions represents the first law of thermodynamics?

a) $\Delta E = -q + W$ b) $\Delta E = q - W$ c) $\Delta E = q + W$ d) $\Delta E = -q - W$

254. A thermodynamic state function is:

a) One which obeys all the laws of thermodynamics

b) A quantity which is used to measure thermal changes

c) A quantity whose value is independent of the path

d) A quantity which is used to express pressure-volume work

255. When two atoms of hydrogen combine to form a molecule of hydrogen gas, the energy of the molecule is:

a) Greater than that of separate atoms

b) Equal to that of separate atoms

c) Lower than that of separate atoms

d) Sometimes lower and sometimes higher

256. The enthalpies of formation of $N_2O$ and NO are 28 and 90 kJ $mol^{-1}$ respectively. The enthalpy of the reaction, $2N_2O(g) + O_2(g) \longrightarrow 4NO(g)$ is equal to :

a) 8 kJ b) 88 kJ c) $-16$ kJ d) 304 kJ

257. Heat of combustion of $CH_4, C_2H_4, C_2H_6$ are $-890, -1411$ and $-1560$ kJ/mol respectively. Which has the lowest calorific fuel value in kJ/g?

a) $CH_4$ b) $C_2H_4$ c) $C_2H_6$ d) All same

258. Given that $\Delta H_{r298\,K} = -54.07$ kJ $mol^{-1}$ and $\Delta S^{\circ}_{r298\,K} = 10$ J $mol^{-1}$ and $R = 8.314$ $JK^{-1}mol^{-1}$. The value of $\log_{10} K$ for a reaction, $A \rightleftharpoons B$ is:

a) 5 b) 10 c) 95 d) 100

259. Hess's law is based on

a) Law of conservation of mass b) Law of conservation of energy

c) First law of thermodynamics d) None of the above

260. What is the entropy change (in $JK^{-1}mol^{-1}$) 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)
a) 20.13 b) 2.013 c) 2.198 d) 21.98

261. Which is an extensive property of the system?
a) Temperature b) Volume c) Refractive index d) Viscosity

262. For the reaction; $C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$ which one is true?
a) $\Delta H = \Delta U - RT$
b) $\Delta H = \Delta U + RT$
c) $\Delta H = \Delta U + 2RT$
d) $\Delta H = \Delta U - 2RT$

263. The heat atomisation of $PH_3(g)$ is 228 kcal per mol and that of $P_2H_4(g)$is 335 kcal per mol. The energy of P − P bond is
a) 102 kcal/mol b) 31 kcal/mol c) 26 kcal/mol d) 204 kcal/mol

264. If, $H_2(g) + Cl_2(g) \rightarrow 2HCl;\ \Delta H^\circ = -44$ kcal
$2Na(s) + 2HCl(g) \rightarrow 2NaCl(s) + H_2(g);$
$\Delta H = -152$ kcal then,
$Na(s) + 0.5\ Cl_2(g) \rightarrow NaCl(s);\ \Delta H^\circ = ?$
a) 108 kcal
b) 196 kcal
c) −98 kcal
d) 54 kcal

265. From the reaction, $P_{(white)} \longrightarrow P_{(red)};\ \Delta H = -18.4$ kJ it following that :
a) Red P is readily formed from white P
b) White P is readily formed from red P
c) White P cannot be converted to red P
d) White P can be converted into red P and red P is more stable

266. If $H^+ + OH^- \longrightarrow H_2O + 13.7$ kcal then the heat of neutralization for complete neutralization of one mole of $H_2SO_4$ by a base will be :
a) − 13.7 kcal b) − 27.4 kcal c) − 6.85 kcal d) − 3.425 kcal

267. Assuming that water vapours are ideal gas. The change in internal energy ($\Delta U$) when 1 mol of water is vaporized at 1 bar pressure and 100°C. (Given molar enthalpy of vaporization at 1 bar and 373 K is 41 kJ $mol^{-1}$ and $R = 8.3$ J $mol^{-1}\ K^{-1}$) will be:
a) 41.00 kJ $mol^{-1}$ b) 4.100 kJ $mol^{-1}$ c) 3.7904 kJ $mol^{-1}$ d) 37.904 kJ $mol^{-1}$

268. Change in entropy for a reaction is given by:
a) $2.303\ nR \log_{10} \frac{V_2}{V_1}$ b) $nR \log_e \frac{V_2}{V_1}$ c) $nR \log_e \frac{P_1}{P_2}$ d) All of these

269. At constant pressure and temperature, the direction of any chemical reaction is one where, the ... decrease.
a) Entropy b) Enthalpy c) Gibbs energy d) None of these

270. Which of the following conditions will always lead to a non spontaneous change?
a) Positive $\Delta H$ and positive $\Delta S$ b) Negative $\Delta H$ and negative $\Delta S$
c) Positive $\Delta H$ and negative $\Delta S$ d) Negative $\Delta S$ and positive $\Delta S$

271. Equal volume 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:
a) 0.83 b) 1.50 c) 3.3 d) 1.67

272. Two atoms of hydrogen combine to form a molecule of hydrogen gas, the energy of the $H_2$ molecule is :
a) Greater than that of separate atoms
b) Equal to that of separate atoms
c) Lower than that of separate atoms

d) Sometimes lower and sometimes higher

273. The heats of neutralization of four acids $A, B, C$ and $D$ are – 13.7, –9.4, –11.2 and –12.4 kcal respectively when they are neutralized by a common base. The acidic character obeys the order :

a) $A > B > C > D$ b) $A > D > C > B$ c) $D > C > B > A$ d) $D > B > C > A$

274. $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l);\ \Delta H = -68$ kcal. The heat change, for the decomposition of 3.6 g of water is :

a) 136 kcal b) 13.6 kcal c) 1.36 kcal d) 68 kcal

275. When 500 J heat is given to the gas $X$ in an isobaric process its work done comes out as 142.8 J. The gas $X$ is

a) $O_2$ b) $NH_3$ c) He d) $SO_2$

276. Diborane is a potential rocket fuel which undergoes combustion according to the equation

$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(g) + 3H_2O(g)$

Calculate the enthalpy change for the combustion of diborane. Given

(i) $2B(s) + \frac{3}{2}O_2(g) \rightarrow B_2O_3(s); \Delta H = -1273$ kJ per mol

(ii) $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l);\ \Delta H = -286$ kJ per mol

(iii) $H_2O(l) \rightarrow H_2O(g);\ \Delta H = 44$ kJ per mol

(iv) $2B(s) + 3H_2(g) \rightarrow B_2H_6(g); \Delta H = 36$ kJ per mol

a) +2035 kJ per mol b) −2035 kJ per mol c) +2167 kJ per mol d) −2167 kJ per mol

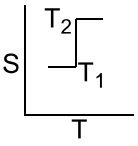
277. To calculate the amount of work done in joules during reversible isothermal expansion of an ideal gas, the volume must be expressed in

a) $m^3$ only b) $dm^3$ only c) $cm^3$ only d) Any of these

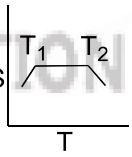
278. Calorific value of carbohydrates is approximately:

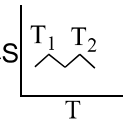
a) 4.0 kcal/g b) 16.0 kcal/g c) 20 kcal/g d) 9.0 kcal/g

279. For a given substance $T_1$ and $T_2$ are freezing point and melting point of a substance. Which of the graph represents correctly, the variation of $\Delta S$ with temperature?

a) 


b) 


c) 


d) 


280. Which is correct for an endothermic reaction?

a) $\Delta H$ is positive b) $\Delta H$ is negative c) $\Delta E$ is negative d) $\Delta H = 0$

281. When a solid melts, there is:

a) An increase in enthalpy
b) No change in enthalpy
c) A decrease in enthalpy
d) A decrease in internal energy

282. Maximum entropy will be in which of the following?

a) Ice b) Liquid water c) Snow d) Water vapour

283. When enthalpy and entropy change for a chemical reaction are $-2.5 \times 10^3$ cal and 7.4 cal $deg^{-1}$ respectively predict the reaction at 298 K is

a) Spontaneous b) Reversible c) Irreversible d) Non-spontaneous

284. A closed flask contains water in all its three states, solids, liquid and vapour at 0°C. In this situation the average KE of the water molecule will be:

a) Maximum in vapour state
b) Maximum in solid state
c) Greater in the liquid than in vapour state
d) Same in all the three states

285. If $C(s) + O_2(g) \rightarrow CO_2(g);\ \Delta H = r$

and $CO(g) + \frac{1}{2}O_2 \rightarrow CO_2(g)$; $\Delta H = s$ then, the heat of formation of CO is

a) $r+s$ b) $r$-$s$ c) $s - r$ d) $rs$

286. The value of $\Delta H^\circ$ for the reaction $Cu^+(g) + I^-(g) \rightarrow CuI(g)$ is $-446$ kJ $mol^{-1}$. If the ionisation energy of Cu(g) is 745 kJ $mol^{-1}$, and the electron affinity of (I)g is $-295$kJ $mol^1$, then the value of $\Delta H^\circ$ for the formation of one mole of CuI(g) from Cu(g) and I(g) is :

a) $-446$ kJ $mol^{-1}$ b) 450 kJ $mol^{-1}$ c) 594 kJ $mol^{-1}$ d) 4 kJ $mol^{-1}$

287. The entropy of the universe:

a) Increasing and tending towards maximum value
b) Decreasing and tending to be zero
c) Remains constant
d) Decreasing and increasing with a periodic rate

288. The internal energy of a substance

a) Increases with increase in temperature
b) Decreases with increases in temperature
c) Can be calculated by the relation $E = mc^2$
d) Remains unaffected with change in temperature

289. $\Delta H_f$ of graphite is 0.23 kJ/mol and $\Delta H_f$ of diamond is 1.896 kJ/mole. $\Delta H_{transition}$ from graphite to diamond is :

a) 1.66 kJ/mole b) 2.1 kJ/mole c) 2.33 kJ/mole d) 1.5 kJ/mole

290. When two moles of hydrogen expands isothermally against a constant pressure of 1 atm, at 25℃ from 15 L to 50 L, the work done (in litre atm) will be

a) 17.5 b) 35 c) 51.5 d) 70

291. Which value of heat of formation indicates that the product is the least stable?

a) $-$ 94 kcal b) $-$ 231.6 cal c) + 21.4 kcal d) + 64.8 kcal

292. The heat of combustion for C, $H_2$ and $CH_4$ are $-$ 349.0, $-241.8$ and $-$ 906.7 kJ respectively. The heat of formation of $CH_4$ is :

a) 174.1 kJ b) 274.1 kJ c) 374.1 kJ d) 74.1 kJ

293. Given,

(i)$S + O_2 \rightarrow SO_2$, $\Delta H = -298.2$ kJ
(ii)$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3$, $\Delta H = -98.7$ kJ
(iii)$SO_3 + H_2O \rightarrow H_2SO_4$, $\Delta H = -130.2$ kJ
(iv)$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$, $\Delta H = -287.3$ kJ

Then the enthalpy of formation of $H_2SO_4$ at 298 K will be

a) $-814.4$ kJ b) $+320.5$ kJ c) $-650.3$ kJ d) $-933.7$ kJ

294. Based on the first law of thermodynamics, which one of the following is correct?

a) For an isochoric process=$\Delta E = -Q$ b) For an adiabatic process=$\Delta E = -W$
c) For an isothermal process=$Q = +W$ d) For a cyclic process=$Q = -W$

295. According to Hess's law, the heat of reaction depends upon

a) Initial condition of reactants b) Initial and final conditions of reactants
c) Intermediate path of the reaction d) End conditions of reactants

296. In which case, a spontaneous reaction is possible at any temperature?

a) $\Delta H -$ ve, $\Delta S +$ ve b) $\Delta H -$ ve, $\Delta S -$ ve c) $\Delta H +$ ve, $\Delta S +$ ve d) In none of the cases

297. Select the incorrect statement :

a) Combustion of $F_2$ is exothermic
b) Combustion of $N_2$ to $N_2O$ is endothermic
c) A good fuel have higher calorific value
d) Nutrition calorie = $10^3$ calories or 1 cal or 1 kcal

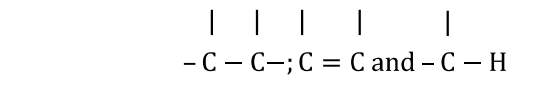
298. The enthalpy change for the following reaction. $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$ is $-57$ kJ. Predict the value of the enthalpy change in the following reaction : $Ba(OH)_2 + H_2SO_4(aq) \rightarrow BaSO_4\ (s) + 2H_2O(l)$
a) $-57$ kJ b) $-76$ kJ c) $-114$ kJ d) $-228$ kJ

299. At 27°C one mole of an ideal gas is compressed isothermally and reversible from a pressure of 2 atm to 10 atm. The value of $\Delta E$ and $q$ are ($R$=2 cal)
a) 0, -965.84 cal b) -965.84 cal, -865.58 cal
c) +865.58 cal, -865.58 cal d) +965.84 cal, +865.58 cal

300. 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) $N_2(g, 10\ atm) \longrightarrow N_2(g, 1\ atm)$
d) Fe (1 mol, 400 K) $\longrightarrow$ Fe(1 mol, 300 K)

301. Hess's law is related to:
a) Change in heat during a reaction
b) Rates of reaction
c) Equilibrium constant
d) Influence of pressure on volume of a gas

302. Heat of dissociation of benzene of elements is 5335 kJ/mol. The bond enthalpies of



bonds are 347.3, 615 and 416.2 kJ respectively. Resonance energy of benzene is
a) 1.15 kJ b) 15.1 kJ c) 937.2 kJ d) 1511 kJ

303. 2 mole of ideal gas at 27°C temperature is expanded reversibly from 2 litre to 20 litre. Find entropy change ($R = 2$ cal/mol K).
a) 92.1 b) 0 c) 4 d) 9.2

304. Work done by the system on surroundings is:
a) Positive b) Negative c) Zero d) None of these

305. What is $\Delta E$ for system that does 500 cal of work on surrounding and 300 cal of heat is absorbed by the system?
a) -200 cal b) -300 cal c) +200 cal d) +300 cal

306. Which fuel provides the highest calorific value?
a) Charcoal b) Kerosene c) Wood d) Dung

307. The value of $\Delta E$ for combustion of 16 g of $CH_4$ is -885389 J at 298 K. The $\Delta H$ combustion for $CH_4$ in J $mol^{-1}$ at this temperature will be
(Given that, $R = 8.314\ JK^{-1}\ mol^{-1}$)
a) $-55337$ b) $-880430$ c) $-885389$ d) $-890348$

308. Human body is an example of
a) Open system b) Closed system c) Isolated system d) None of these

309. A hypothetical reaction $A \rightarrow 2B$, proceeds through following sequence of steps
(i) $A \rightarrow C; \Delta H = q$ (ii) $C \rightarrow D; \Delta H = v$
(iii) $\frac{1}{2}D \rightarrow B;\ \Delta H = x$
Then the heat of reaction i
a) $q - v + 2x$ b) $q + v - 2x$ c) $q + v + 2x$ d) $q + 2v - 2x$

310. The entropy of crystalline substances at absolute zero by the third law of thermodynamics should be taken as

a) 100 b) 50
c) Zero d) Different for different substance

311. Identify the state quantity among the following:
a) $q$ b) $q - W$ c) $q + W$ d) $q/W$

312. For the following two reactions,
(i)$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O$
$\Delta H = -890.4$ kJ
(ii)$2HgO(s) \rightarrow 2Hg(l) + O_2(g) - 181.6$ kJ
Which one of the following statements is correct?
a) Both of them are exothermic
b) Both of them are endothermic
c) (i) is exothermic and (ii) is endothermic
d) (i) is endothermic and (ii) is exothermic

313. From the following data, the heat of formation of $Ca(OH)_2(s)$ at 18°C is .....kcal:
$CaO(s) + H_2O(l) = Ca(OH)_2(s)$;
$\Delta H = -15.26$ kcal ….(i)
$H_2O(l) = H_2(g) + \frac{1}{2}O_2(g)$;
$\Delta H = 68.37$ kcal … … (ii)
$Ca(s) + \frac{1}{2}O_2(g) = CaO(s)$;
$\Delta H = -151.80$ kcal … … (iii)
a) $-98.69$
b) $-235.43$
c) 194.91
d) 98.69

314. If $\frac{1}{2}X_2O(s) \longrightarrow X(s) + \frac{1}{4}O_2(g)$; $\Delta H = 90$ kJ, then heat change during reaction of metal '$X$' with one more of $O_2$ to form oxide to maximum extent is :
a) 360 KJ b) $-360$ KJ c) $-180$ KJ d) $+180$ KJ

315. Decrease in Gibbs energy of a reacting system indicates to:
a) Exothermic reaction b) Equilibrium reaction c) Spontaneous reaction d) Slow reaction

316. $S + \frac{3}{2}O_2 \rightarrow SO_3 + 2x$ kcal;
$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 + y$ kcal;
The heat of formation of $SO_2$ is :
a) $y - 2x$ b) $(2x + y)$ c) $(x + y)$ d) $2x/y$

317. The standard molar heat of formation of ethane, $CO_2$ and water $(l)$ are respectively $-21.1 - 94.1$ and $-68.3$ kcal. The standard molar heat of combustion of ethane will be
a) $-372$ kcal b) 162 kcal c) $-240$ kcal d) 183.5 kcal

318. Among them intensive property is
a) Mass b) Volume c) Surface tension d) Enthalpy

319. Equal volume of $C_2H_2$ and $H_2$ are combusted under identical condition. The ratio of their heat of combustion is :
$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$; $\Delta H = -241.8$ kJ
$C_2H_2(g) + 2\frac{1}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(g)$;
$\Delta H = -1300$ kJ

a) 5.37/1
b) 1/5.37
c) 1/1
d) None of these

320. 1 litre − atmosphere is equal to:
a) 101.3 J b) 24.206 cal c) $101.3 \times 10^7$ erg d) All of these

321. For the precipitation of AgCl by $Ag^+$ ions and HCl:
a) $\Delta H = 0$ b) $\Delta G = 0$ c) $\Delta G = -ve$ d) $\Delta H = \Delta G$

322. When a certain amount of ethylene was burnt 6226 kJ heat was evolved. If heat of combustion of ethylene is 1411 kJ, the volume of $O_2$ (at NTP) that entered into the reaction is:
a) 296.5 mL b) 296.5 litre c) 6226 × 22.4 litre d) 22.4 litre

323. The heat change for the reaction, $C(s) + 2S(s) \longrightarrow CS_2(l)$ is called:
a) Heat of solution of $CS_2$
b) Heat of fusion of $CS_2$
c) Heat of formation of $CS_2$
d) Heat of combustion of carbon

324. Given enthalpy of formation of $CO_2(g)$ and CaO(s) are −94.0 kJ and −152 kJ respectively and the enthalpy of the reaction, $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ is 42 kJ. The enthalpy of formation of $CaCO_3(s)$ is :
a) − 42 kJ b) − 202 kJ c) + 202 kJ d) − 288 kJ

325. The ratio of slopes of $\log P$ *vs* $\log V$ for reversible adiabatic process and reversible isothermal process of an ideal gas is equal to:
a) $\gamma$ b) $1 - \gamma$ c) $\gamma - 1$ d) $\frac{1}{\gamma}$

326. In which of the following processes of neutralization magnitude of $\Delta H_{neutralisation}$ is less than that of $\Delta H_{ionisation}$ of water?
a) HCl + NaOH b) $H_2SO_4$ + NaOH c) $CH_3COOH$ + NaOH d) $HClO_4$ + KOH

327. A boiled egg show a/an ...in entropy.
a) Increase b) Decrease c) No change d) None of these

328. Which unit represents largest amount of energy?
a) Calorie b) Joule c) Erg d) Electron volt

329. The heat of combustion of carbon to $CO_2$ is −393 kJ/mol. The heat released upon formation of 35.2 g of $CO_2$ from carbon and oxygen gas is
a) +325 kJ b) −31.5 kJ c) −315 kJ d) +31.5 kJ

330. A thermally isolated gaseous system can exchange energy with the surroundings. The mode of transference of energy can be:
a) Heat b) Work c) Heat and radiation d) None of these

331. Warming ammonium chloride with sodium hydroxide in a test tube is an example of:
a) Closed system b) Isolated system c) Open system d) None of these

332. Identify the correct statements regarding entropy
a) At 0°C, the entropy of a perfectly crystalline substance is taken to be zero
b) At absolute zero of temperature, the entropy of all perfectly crystalline substance is positive
c) At absolute zero of temperature, the entropy of all crystalline substance is taken to be negative
d) At absolute zero of temperature, the entropy of a perfectly crystalline substance is taken to be zero

333. The matter has highest entropy in:
a) Solid state b) Liquid state c) Gaseous state d) Equal in all

334. $H_2(g) + \frac{1}{2}O_2(g) = H_2O(l)$; $\Delta H_{298K} = -68.32$ kcal. Heat of vaporization of water at 1 atm and 25°C is 10.52 kcal. The standard heat of formation (in kcal) of 1 mole of water vapour at 25°C is :
a) −78.84 b) 78.84 c) + 57.80 d) −57.80

335. For vaporization of water at 1 atmospheric pressure, the values of $\Delta H$ and $\Delta S$ are 40.63 kJ $mol^{-1}$ and

$108.8\ JK^{-1}mol^{-1}$, respectively. The temperature when Gibbs energy change ($\Delta G$) for this transformation will be zero, is:

a) 273.4 K b) 393.4 K c) 373.4 K d) 293.4 K

336. For an adiabatic process:

a) $Q = +W$ b) $Q = 0$ c) $\Delta U = q$ d) $P\Delta V = 0$

337. The $\Delta H^{\circ}_{\text{ionisation}}$ for HCN and $CH_3COOH$ are 45.2 and 2.1 kJ $mol^{-1}$.Which of the following correct?

a) $pKa_{HCN} < pKa_{CH_3COOH}$

b) $pKa_{HCN} > pKa_{CH_3COOH}$

c) $pKa_{HCN} = pKa_{CH_3COOH}$

d) None of the above

338. Which of the following taking place in the blast furnace is endothermic?

a) $CaCO_3 \rightarrow CaO + CO_2$ b) $2C + O_2 \rightarrow 2CO$

c) $C + O_2 \rightarrow CO_2$ d) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

339. Hess's law is used to calculate

a) Enthalpy of reaction b) Entropy of reaction

c) Work done in reaction d) All of these

340. For spontaneity of a cell, which is correct?

a) $\Delta G = 0, \Delta E = 0$ b) $\Delta G = -\text{ve}, \Delta E = 0$ c) $\Delta G = +\text{ve}, \Delta E = +\text{ve}$ d) $\Delta G = -\text{ve}, \Delta E = +\text{ve}$

341. If heat of neutralisation is $-13.7$kcal and $H_f^0$ $H_2O = -68$ kcal, then enthalpy of $OH^-$ would be :

a) 54.3 kcal b) $-54.3$ kcal c) 71.3 kcal d) $-71.3$ kcal

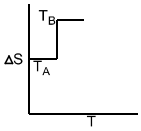
342. Work done in reversible isothermal process is given by:

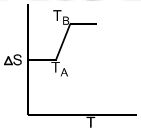
a) $2.303\ RT \log\frac{V_2}{V_1}$ b) $\frac{nR}{(\gamma - 1)}(T_2 - T_1)$ c) $2.303\ RT \log\frac{V_1}{V_2}$ d) None of these

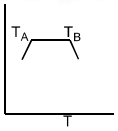
343. Internal energy of an ideal gas depends on:

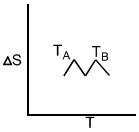
a) Pressure b) Temperature c) Volume d) None of these

344. For a given substance, melting point $T_B$ and freezing point is $T_A$, which of the following represents correct variation of $\Delta S$ *vs* $T$?

a) 


b) 


c) 


d) 


345. Bond energies of (H—H), (O〓O) and (O—H) are 105, 120 and 220 kcal/mol respectively, then $\Delta H$ in the reaction , $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$:

a) $-115$ b) $-130$ c) $-118$ d) $-550$

346. The apparatus generally used for measuring heat changes is:

a) Voltameter b) Voltmeter c) Calorimeter d) Coulometer

347. The enthalpy change for the process, $C(s) \longrightarrow C(g)$ is known as enthalpy of :

a) Fusion b) Vaporisation c) Combustion d) Sublimation

348. Standard heat of formation of $CH_4(g), CO_2(g)$ and water 25°C are $-17.9, -94.1$ and $-68.3$ kcal $mol^{-1}$ respectively. Calculate the heat change (in kcal) in the following reaction at 25°C:

$$CH_4(g) + 2O_2(g) = CO_2(g) + 2H_2O(l)$$

a) $-144.5$ b) $-180.3$ c) $-248.6$ d) $-212.8$

349. Which is the best definition of heat of neutralization?

a) The heat absorbed when one gram molecule of an acid is neutralized by one gram molecule of a base in dilute solution at a stated temperature

b) The heat set free or absorbed when one gram atom of an acid is neutralized by one gram atom of a base at a stated temperature

c) The heat set free or absorbed when a normal solution containing one gram-equivalent

d) The heat set free when one gram-equivalent of an acid is neutralized by one gram-equivalent of a

of an acid neutralized by a normal solution containing one gram-equivalent of a base at a stated temperature
base in dilute solution at a stated temperature

350. Thermochemistry is the study of relationship between heat energy and :
a) Chemical energy b) Activation energy c) Frictional energy d) None of these

351. Enthalpy change for the reaction, $4H(g) \rightarrow 2H_2(g)$ is – 869.6 kJ
The dissociation energy of H—H bond is :
a) + 217.4 kJ b) − 434.8 kJ c) − 869.6 kJ d) + 434.8 kJ

352. Which of the following is true for an adiabatic process?
a) $\Delta H = 0$ b) $\Delta W = 0$ c) $\Delta q = 0$ d) $\Delta V = 0$

353. Which of the following is an intensive property?
a) Volume b) Enthalpy c) Surface tension d) Free energy

354. $C_6H_{12}(l) + 9O_2(g) = 6H_2O(l) + 6CO_2(g)$; $\Delta H_{298K} = -936.9$ kcal. Thus :
a) $-936.9 = \Delta U - (2 \times 10^{-3} \times 298 \times 3)$ kcal
b) $+936.9 = \Delta U + (2 \times 10^{-3} \times 298 \times 3)$ kcal
c) $-936.9 = \Delta U - (2 \times 10^{-3} \times 298 \times 2)$ kcal
d) $-936.9 = \Delta U + (2 \times 10^{-3} \times 298 \times 2)$ kcal

355. The work done by a weightless piston in causing an expansion $\Delta V$ (at constant temperature), when the opposing pressure, $P$ is variable, is given by:
a) $W = -\int P\Delta V$ b) $W = 0$ c) $W = -P\Delta V$ d) None of these

356. If a gas has 2 atm and 5 atm pressure at 30°C and 27°C respectively. Then it will
a) Cool on expansion b) Warm on expansion
c) No change on expansion d) None of these

357. Two moles of helium gas expanded isothermally and irreversible at 27°C from volume 1 $dm^3$ to 1 $m^3$ at constant pressure of 100 k Pa. Calculate the work done.
a) 99900 kJ b) 99900 J c) 34464.65 kJ d) 34464.65 J

358. The efficiency of heat engine is maximum when:
a) Temperature of source > temperature of sink
b) Temperature of sink > temperature of source
c) Temperature difference of source and sink is minimum
d) Temperature difference of source and sink is maximum

359. Which one of the following has $\Delta S°$ greater than zero?
a) $CaO + CO_2(g) \rightleftharpoons CaCO_3(s)$ b) $NaCl(aq) \rightleftharpoons NaCl(s)$
c) $NaNO_3(s) \rightleftharpoons Na^+(aq) + NO_3^-(aq)$ d) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

360. A spontaneous change is one in which the system suffers
a) A lowering of entropy b) No energy change
c) An increase in internal energy d) A lowering of free energy

361. Which of the following are not state functions?
(I) $q + w$ (II) $q$
(III) $w$ (IV) $H - TS$
a) (II), (III) and (IV) b) (I), (II) and (III) c) (II) and (III) d) (I) and (IV)

362. An isolated system is that system in which:
a) There is no exchange of energy with the surroundings
b) There is exchange of mass and energy with the surroundings
c) There is no exchange of mass and energy with the surroundings
d) There is exchange of mass with the surroundings

363. Thermodynamics is concerned with:
a) Total energy of a system

b) Energy changes in a system
c) Rate of chemical change
d) Mass changes in nuclear reactions

364. Which of the reactions defines $\Delta H^{\circ}f$ ?
a) $C_{(diamond)} + O_2(g) \rightarrow CO_2(g)$
b) $\frac{1}{2}H_2(g) + \frac{1}{2}F_2(g) \rightarrow HF(g)$
c) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
d) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

365. A process is taking place at constant temperature and pressure. Then
a) $\Delta H = \Delta E$ b) $\Delta H = T\Delta S$ c) $\Delta H = 0$ d) $\Delta S = 0$

366. An isothermal process is associated with:
a) Constant entropy
b) Constant temperature
c) Constant enthalpy
d) Large change in heat content

367. $C(s) + O_2(g) \rightarrow CO_2(g);\ \Delta H = -94$ kcal
$2CO(g) + O_2 \rightarrow 2CO_2(g);\ \Delta H = -135.2$ kcal
The heat of formation of $CO(g)$ is
a) -26.4 kcal b) 41.2 kcal c) 26.4 kcal d) 229.2 kcal

368. $C_{graphite} + O_2(g) \rightarrow CO_2(g);$
$\Delta H = -94.05$ kcal mol$^{-1}$
$C_{diamond} + O_2(g) \rightarrow CO_2(g);$
$\Delta H = -94.05$ kcal mol$^{-1}$ therfore :
a) $C_{diamond} \rightarrow C_{graphite}$ ; $\Delta H^{\circ}_{298K} = +450$ cal mol$^{-1}$
b) $C_{graphite} \rightarrow C_{diamond}$ ; $\Delta H^{\circ}_{298K} = -450$ cal mol$^{-1}$
c) Diamond is harder than graphite
d) Graphite is the stabler allotrope

369. Enthalpy change for a reaction does not depend upon
a) The physical states of reactants and products
b) Use of different reactants for the same products
c) The nature of intermediate reaction steps
d) The differences in initial and final temperature of involved substances

370. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?
a) $q = 0, \Delta T < 0, w \neq 0$ b) $q = 0, \Delta T \neq 0, w = 0$ c) $q \neq 0, \Delta T = 0, w = 0$ d) $q = 0, \Delta T = 0, w = 0$

371. For a reaction at 25°C enthalpy change ($\Delta H$) and entropy change ($\Delta S$) are $-11.7 \times 10^3$ J mol$^{-1}$ and $-105$ J mol$^{-1}$K$^{-1}$ respectively. The reaction is:
a) Spontaneous b) Non-spontaneous c) Instantaneous d) None of these

372. Which of the following is a path function?
a) Internal energy b) Enthalpy c) Work d) Entropy

373. The work done by a system is 8 J, when 40 J heat is supplied to it. The change in internal energy of the system during the process is:
a) 32 J b) 40 J c) 36 J d) 44 J

374. Heat of reaction at constant volume is equal to :
a) $\Sigma U_P - \Sigma U_R$ b) $\Sigma U_R - \Sigma U_P$ c) $\Sigma H_P - \Sigma H_R$ d) $\Sigma H_R - \Sigma H_P$

375. Boiling point of a liquid is 50 K at 1 atm and $\Delta H_{vap.} = 460.6$ cal mol$^{-1}$. What will be its b. p. at 10 atm?
a) 150 K b) 75 K c) 100 K d) 200 K

376. The change in the enthalpy during the reaction, $NaOH + HCl \rightarrow NaCl + H_2O$, is called :
a) Heat of reaction b) Heat of neutralization c) Heat of formation d) Heat of liquefaction

377. The heat of combustion of rhombic and monoclinic sulphur are 70.96 and 71.03 kcal. The heat of transition of $S_{R \rightarrow M}$ is:
a) 70.96 kcal b) 71.03 kcal c) $-70$ cal d) $+70$ cal

378. Hess law is applicable for the determination of heat of
a) Reaction b) Formation c) Transition d) All of these

379. A heat engine absorbs heat $Q_1$ at temperature $T_1$ and heat $Q_2$ at temperature $T_2$, work done by the engine is $(Q_1 + Q_2)$ this data
a) Violates 1st law of thermodynamics
b) Violates 1st law of thermodynamics if $a_1$ is –ve
c) Violates 1st law of thermodynamics if $a_2$ is $-$ve
d) Does not violates 1st law of thermodynamics

380. In which of the following condition a chemical reaction can not occur?
a) $\Delta H$ and $\Delta S$ increase and $T\Delta S > \Delta H$ b) $\Delta H$ and $\Delta S$ decrease and $\Delta H > T\Delta S$
c) $\Delta H$ increase and $\Delta S$ decreases d) $\Delta H$ decreases and $\Delta S$ increases

381. $C_{\text{diamond}} + O_2(g) \longrightarrow CO_2(g);\ \Delta H = -395$ kJ ..... (i)
$C_{\text{graphite}} + O_2(g) \longrightarrow CO_2(g);\ \Delta H = -393.5$ kJ ..... (ii)
The $\Delta H$, when diamond is formed from graphite, is :
a) $-1.5$ kJ b) $+1.5$ kJ c) $+3.0$ kJ d) $-3.0$ kJ

382. Entropy change of fusion at constant pressure is given by:
a) $\Delta S_{(f)} = \frac{\Delta H_f}{T}$ b) $\Delta S_{(f)} = \frac{\Delta G_f}{T}$ c) $\Delta S_{(f)} = \frac{\Delta H_f}{\Delta T}$ d) None of these

383. At 27°C, one mole of an ideal gas is compressed isothermally and reversibly from a pressure of 2 atm to 10 atm. The values of $\Delta E$ and $q$ are $(R = 2)$
a) 0, $-965.84$ cal b) $-965.84$ cal, $-865.58$ cal
c) $+865.58$ cal, $-865.58$ cal d) $-865.58$ cal, $-865.58$ cal

384. When hydrogen and oxygen burn to form water in an oxyhydrogen torch, the entropy change is:
a) Negative
b) Positive
c) Zero
d) May be positive or negative

385. The temperature coefficient of e. m. f. of a cell can be given by:
a) $\left(\frac{\partial E}{\partial T}\right)_P = \frac{\Delta S}{nF}$ b) $\left(\frac{\partial E}{\partial T}\right)_P = \left(\frac{E_2 - E_1}{T_2 - T_1}\right)_P$ c) $\left(\frac{\partial E}{\partial T}\right)_P = \left[\frac{\Delta H}{nF} + E\right]\frac{1}{T}$ d) All of these

386. The internal energy of one mole of a gas is:
a) $\frac{3}{2}RT$ b) $\frac{KT}{2}$ c) $\frac{RT}{2}$ d) $\frac{3KT}{2}$

387. The resultant heat change in a reaction is the same whether it takes place in one or several stages. This statement is called
a) Lavoisier and Laplace law b) Hess's law
c) Joule's law d) Le-Chatelier's principle

388. $\Delta H$ for transition of carbon in the diamond form to carbon in the graphite form, is – 453.5 cal. This suggests that :
a) Graphite is chemically different from diamond
b) Graphite is as stable as diamond
c) Graphite is more stable than diamond
d) Diamond is more stable than graphite

389. The enthalpy of fusion of ice per mole is

a) 18 kJ b) 8 kJ c) 80 kJ d) 6 kJ

390. For the reversible vaporisation of water at 100°C and 1 atmospheric pressure, $\Delta G$ is equal to:
a) $\Delta H$ b) $\Delta S$ c) Zero d) $\Delta H/T$

391. Molar heat of vaporisation of a liquid is 6 kJmol$^{-1}$. If the entropy change is 16 J mol$^{-1}$K$^{-1}$, the boiling point of the liquid is
a) 273 K b) 375°C c) 375 K d) 102°C

392. The enthalpy of fusion of water is 1.435 kcal/mol. The molar entropy change for the melting of ice at 0°C is:
a) 5.260 cal/(mol K) b) 0.526 cal/(mol K) c) 10.52cal/(mol K) d) 21.04 cal/(mol K)

393. Which of the following is an endothermic reaction?
a) $N_2(g) + 3H_2(g) - 92kJ \rightarrow 2NH_3(g)$ b) $N_2(g) + O_2(g) + 180.8\ kJ \rightarrow 2NO(g)$
c) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g) + 184.6\ kJ$ d) $C(graphite) + 2H_2(g) \rightarrow CH_4(g) + 74.8\ kJ$

394. The $\Delta G$ in the process of melting of ice at $-15$°C is:
a) $\Delta G = -ve$ b) $\Delta G = +ve$ c) $\Delta G = 0$ d) All of these

395. A container has hydrogen and oxygen mixture in ratio of 1 : 1 by weight, then
a) Internal energy of the mixture decreases b) Internal energy of the mixture increases
c) Entropy of the mixture increases d) Entropy of the mixture decreases

396. Which one is not a spontaneous process?
a) Dissolution of $CuSO_4$ in water
b) Water flowing down the hills
c) Flow of current from low potential to high potential
d) None of the above

397. 1 mole of gas occupying 3 L volume is expanded against a constant external pressure of 1 atm to a volume of 15 litre. The work done by the system is:
a) $1.215 \times 10^3$ J b) $12.15 \times 10^3$ J c) $121.5 \times 10^3$ J d) None of these

398. The heat evolved during the combustion of 112 litre of water gas (mixture of equal volume of $H_2$ and CO) is :

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g);\ \Delta H = -241.8$ kJ

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g);\ \Delta H = -283$ kJ

a) 241.8 kJ b) 283 kJ c) $-$ 1312 kJ d) 1586 kJ

399. Work done in reversible adiabatic process is given by:
a) $2.303\ RT \log \frac{V_2}{V_1}$ b) $\frac{nR}{(\gamma - 1)}(T_2 - T_1)$ c) $2.303\ RT \log \frac{V_1}{V_2}$ d) None of these

400. The H—H bond energy is 430 kJ mol$^{-1}$ and Cl—Cl bond energy is 240 kJ mol$^{-1}$. $\Delta H$ for HCl is $-90$ kJ. The H—Cl bond energy is about:
a) 425 kJ mol$^{-1}$ b) 213 kJ mol$^{-1}$ c) 360 kJ mol$^{-1}$ d) 180 kJ mol$^{-1}$

401. Given,

$NH_3(g) + 3Cl_2(g) \rightleftharpoons NCl_3(g) + 3HCl(g);\ -\Delta H_1$

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g);\ -\Delta H_2$

$H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g);\ \Delta H_3$

The heat of formation of $NCl_3(g)$ in the terms of $\Delta H_1, \Delta H_2$ and $\Delta H_3$ is:

a) $\Delta H_f = -\Delta H_1 + \frac{\Delta H_2}{2} - \frac{3}{2}\Delta H_3$

b) $\Delta H_f = \Delta H_1 + \frac{\Delta H_2}{2} - \frac{3}{2}\Delta H_3$

c) $\Delta H_f = \Delta H_1 - \frac{\Delta H_2}{2} - \frac{3}{2}\Delta H_3$

d) None of the above

402. 50 mL of water takes 5 min to evaporate from a vessel on a heater connected to an electric source which delivers 400 W. The enthalpy of vaporisation of water is
a) 40.3 kJ per mol b) 43.2 kJ per mol c) 16.7 kJ per mol d) 180.4 kJ per mol

403. The work done by a system in an expansion against a constant external pressure is:
a) $\Delta P \cdot \Delta V$ b) $-P \cdot \Delta V$ c) $Q$ d) $V \cdot \Delta P$

404. If, combustion of 4 g of $CH_4$ liberates 2.5 kcal of heat, the heat of combustion of $CH_4$ is :
a) $-2$ kcal $mol^{-}$ b) $-10$ kcal $mol^{-}$ c) 2.5 kcal $mol^{-1}$ d) $-5$ kcal $mol^{-1}$

405. A gas expands isothermally against a constant external pressure of 1 atm from a volume of 10 $dm^3$ to a volume of 20 $dm^3$. It absorbs 800 J of thermal energy from its surroundings. The $\Delta U$ is
a) $-312$ J b) $+123$ J c) $-213$ J d) $+231$ J

406. Enthalpy of vaporisation for water is 186.5 kJ $mol^{-1}$. The entropy change during vaorisation is ...kJ $K^{-1}mol^{-1}$.
a) 0.5 b) 1.0 c) 1.5 d) 2.0

407. $\Delta C_p$ for : $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$ is :
a) $C_pNH_3 + C_pN_2 + C_pH_2$
b) $C_pNH_3 - C_pN_2 - C_pH_2$
c) $2C_pNH_3 - C_pN_2 - 3C_pH_2$
d) $2C_p\,NH_3 + C_pN_2 - 3C_pH_2$

408. Which statement(s) is/are correct?
a) $\left(\frac{\partial H}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_V = R$
b) $\left(\frac{\partial H}{\partial T}\right)_P > \left(\frac{\partial U}{\partial T}\right)_V$
c) $\left(\frac{\partial U}{\partial V}\right)_T$ for ideal gas is zero
d) All of the above

409. For a reversible process at $T = 300$ K, the volume of 2 mole of ideal gas is increased from 1 litre to 10 litre, the $\Delta H$ for isothermal change is:
a) 11.47 kJ b) 4.98 kJ c) 0 d) 2.49 kJ

410. If $C(s) + 2H_2(g) \rightarrow CH_4(g);\ \Delta H = -X_1$ kcal
$C(g) + 4H(g) \rightarrow CH_4(g);\ \Delta H = -X_2$ kcal
$CH_4(g) \rightarrow CH_3(g) + H(g);\ \Delta H = +Y$ kcal
The average bond energy of C − H bond in kcal $mol^{-1}$ is :
a) $\frac{X_1}{4}$
b) $Y$
c) $\frac{X_2}{4}$
d) $X_1$

411. The enthalpy of formation of $H_2O(l)$ is given by :
a) $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l);\ \Delta H = -X_1$ kJ
b) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l);\quad \Delta H = -X_2$ kJ
c) $CO_2(g) + H_2(g) \longrightarrow CO(g) + H_2O(l);\ \Delta H = -X_3$ kJ
d) $C_2H_2(g) + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(l);\ \Delta H = -X_4$ kJ

412. A gas can expand from 100 mL to 250 mL under a constant pressure of 2 atm. The work done by gas is
a) 30.38 J b) 25 J c) 5 kg J d) 16 J

413. A system is changed from state $A$ to state $B$ by one path and from $B$ to $A$ by another path. If $E_1$ and $E_2$ are the corresponding changes in internal energy, then;
a) $U_1 + U_2 = +ve$ b) $U_1 + U_2 = -ve$ c) $U_1 + U_2 = 0$ d) None of these

414. Three moles of an ideal gas expanded spontaneously into vacuum. The work done will be:
a) Infinite b) 3 joules c) 9 joules d) Zero

415. Which of the following is always negative for exothermic reaction?
a) $\Delta H$ b) $\Delta S$ c) $\Delta G$ d) None of these

416. In a flask colourless $N_2O_4$ is in equilibrium with brown coloured $NO_2$. At equilibrium when the flask is heated at 100°C, the brown colour deepens and on cooling it becomes less coloured. The change in enthalpy, $\Delta H$ for this system is :
a) Negative b) Positive c) Zero d) Undefined

417. If gas at constant temperature and pressure expands then its
a) Internal energy increases and then decreases b) Internal energy increases
c) Internal energy remains the same d) Internal energy decreases

418. If the enthalpy change for the reaction
$$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g),$$
$\Delta H = -25$ kcal. Bond energy of C—H is 20 kcal $mol^{-1}$ greater than the bond energy of C—Cl and bond energies of H—H and H—Cl are same in magnitude, then for the reaction : $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$; $\Delta H = ?$
a) $-22.5$ kcal/mol b) $-20.5$ kcal/mol c) $-32.5$ kcal/mol d) $-12.5$ kcal/mol

419. Internal energy is an example of
a) Path function b) State function c) Both (a) and (b) d) None of these

420. In a closed container, a liquid is stirred with a paddle to increase the temperature. Which of the following is true?
a) $\Delta E = W \neq 0, q = 0$ b) $\Delta E = W = q \neq 0$ c) $\Delta E = 0, W = q \neq 0$ d) $W = 0, \Delta E = q \neq 0$

421. In a reaction, $\Delta H$ and $\Delta S$ both are positive. In which of the following cases, the reaction would not be spontaneous?
a) $\Delta H > T\Delta S$ b) $\Delta S = \frac{\Delta H}{T}$ c) $\Delta H = T\Delta S$ d) All of these

422. The bond dissociation energies of gaseous $H_2$, $Cl_2$ and HClare 104, 58 and 103 kcal respectively. The enthalpy of formation of HClgas would be
a) $-44$ kcal b) 44 kcal c) $-22$ kcal d) 22 kcal

423. The internal energy change when a system goes from state $A$ to $B$ is 40 kJ/mol. If the system goes from $A$ to $B$ by a reversible path and returns to state $A$ by an irreversible path, what would be the net change in internal energy?
a) 40 kJ b) >40 kJ c) <40 kJ d) Zero

424. The enthalpy of vaporisation of a substance is 840 J/mol and its boiling point is $-173$°C. Its entropy of vaporisation is
a) 4.8 J/mol/K b) 12 J/mol/K c) 210 J/mol/K d) 49 J/mol/K

425. The $\Delta H_f^o$ of $O_3, CO_2, NH_3$ and HI are 142.2 $-393.3, -46.2$ and $+25.9$ kJ per mol respectively. The order of their increasing stabilities will be
a) $O_3, CO_2, NH_3, HI$ b) $CO_2, NH_3, HI, O_3$ c) $O_3, HI, NH_3, CO_2$ d) $NH_3, HI, CO_2, O_3$

426. For the reaction, C (graphic)
$+\frac{1}{2}O_2(g) \rightarrow CO(g)$ at 298 K and 1 atm, $\Delta H = -26.4$ kcal. What is $\Delta E$, if the molar volume of graphite is 0.0053 L?
($R = 0.002$ kcal $mol^{-1}$ $K^{-1}$)
a) -26.7 kcal b) +26.7 kcal c) -52.4 kcal d) +52.4 kcal

427. For the reaction of one mole of zinc dust with one mole of sulphuric acid in a bomb calorimeter, $\Delta U$ and $W$ correspond to
a) $\Delta U < 0, W = 0$ b) $\Delta U = 0, W < 0$ c) $\Delta U > 0, W = 0$ d) $\Delta U = 0, W > 0$

428. The quantity of heat measured for a reaction in a bomb calorimeter is equal to
a) $\Delta G$ b) $\Delta H$ c) $p\Delta V$ d) $\Delta E$

429. For the reactions:
$C + O_2 \rightarrow CO_2;\ \Delta H = -393$ kJ
$2Zn + O_2 \rightarrow 2ZnO;\ \Delta H = -412$ kJ
which one is correct?
a) Carbon can reduce ZnO to Zn
b) Oxidation of carbon is not feasible
c) Oxidation of Zn is not feasible
d) Zn liberates more heat than carbon during oxidation

430. The following two reactions are known
$Fe_2O_3(s) + 3CO_{(g)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)};\ \Delta H = -26.8$ kJ
$FeO_{(s)} + CO_{(g)} \rightarrow Fe_{(s)} + CO_{2(g)};\ \Delta H = -16.5$ kJ
The value of $\Delta H$ for the following reaction
$Fe_2O_{3(s)} + CO_{(g)} \rightarrow 2FeO_{(s)} + CO_{2(g)}$ is :
a) $+ 10.3$ kJ
b) $- 43.3$ kJ
c) $-10.3$ kJ
d) $+ 6.2$ kJ

431. The process in which pressure remains constant throughout a change is:
a) Adiabatic b) Isochoric c) Isobaric d) Isothermal

432. Entropy of vaporisation of water at 100°C, if molar heat of vaporisation is 9710 cal $mol^{-1}$ will be:
a) 20 cal $mol^{-1}K^{-1}$ b) 26.0 cal $mol^{-1}K^{-1}$ c) 24 cal $mol^{-1}K^{-1}$ d) 28.0 cal $mol^{-1}K^{-1}$

433. Which is an extensive property?
a) Temperature b) Chemical potential c) Gibb's free energy d) Molar volume

434. $\Delta E°$of combustion of isobutylene is – $x$ kJ $mol^{-1}$. The value of $\Delta H°$ is
a) $= \Delta E°$ b) $> \Delta E°$ c) $= 0$ d) $< \Delta E°$

435. Which of the following reaction defines $\Delta H_f^o$?
a) $C(\text{diamond}) + O_2(g) \rightarrow CO_2(g)$
b) $\frac{1}{2}H_2(g) + \frac{1}{2}F(g) \rightarrow HF(g)$
c) $N_2(l) + 3H_2(g) \rightarrow 2NH_3(g)$
d) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

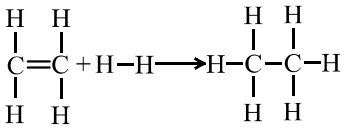
436. The heat change for the reaction, $H_2O(l) \longrightarrow H_2O(g)$ is called as :
a) Heat of vaporisation b) Heat of solution c) Heat of fusion d) Heat of formation

437. The law of conservation of energy states that :
a) The internal energy of a system is constant
b) The heat content of a system is constant
c) Energy is neither created nor destroyed
d) There is an equivalence between energy and mass

438. Heat of neutralization of HF is :
a) 1. kJ b) > 57.32 kJ c) < 57.32 kJ d) None of these

439. From the following bond energies :
H—H bond energy : 431.37 kJ $mol^{-1}$
C〓C bond energy : 606.10 kJ $mol^{-1}$

C—C bond energy : 336.49 kJ $mol^{-1}$
C—H bond energy : 410.50 kJ $mol^{-1}$
Enthalpy for the reaction,



will be :
a) 553.0 kJ $mol^{-1}$ b) 1523.6 kJ $mol^{-1}$ c) $-$ 243.6 kJ $mol^{-1}$ d) $-$ 120.0 kJ $mol^{-1}$

440. The enthalpies of formation of organic substances can be conveniently determined from :
a) Heats of combustion data
b) Boiling point
c) Melting point
d) Heats of neutralisation

441. The free energy change for a reversible reaction at equilibrium is
a) Large, positive b) Small, negative c) Small, positive d) 0

442. In an irreversible process, the value of $\Delta S_{system} + \Delta S_{surr}$ is:
a) +ve b) −ve c) $= 0$ d) All of these

443. A container has hydrogen and oxygen mixture in ratio of 4 : 1 by weight, then:
a) Entropy of these gases increase
b) Internal energy increases
c) Internal energy of the gas decreases
d) Entropy of the gases decrease

444. Equal volume of 1$M$ HCl and 1 $M$ $H_2SO_4$ are neutralised by dilute NaOH solution and $x$ and $y$ kcal of heat are liberated respectively. Which of the following is true?
a) $x = y$ b) $x = 0.5\ y$ c) $x = 0.4\ y$ d) None of these

445. Identify the intensive quantity from the following
a) Enthalpy and temperature b) Volume and temperature
c) Enthalpy and volume d) Temperature and refractive index

446. A mixture of hydrogen and chlorine on exposure to ultra violet sunlight reacts with explosion. The step involved in the initiation of the reaction is :
a) $H_2 \longrightarrow H^{\bullet} + H^{\bullet}$ b) $Cl^{\bullet} + Cl^{\bullet} \longrightarrow Cl_2$ c) $H_2 + Cl_2 \longrightarrow 2HCl$ d) $Cl_2 \longrightarrow Cl^{\bullet} + Cl^{\bullet}$

447. The amount of heat measured for a reaction in a bomb calorimeter is
a) $\Delta G$ b) $\Delta H$ c) $\Delta E$ d) $p.\Delta V$

448. The mathematical form of the first law of thermodynamics when heat ($q$) is supplied and $W$ is work done by the system (+ve) is:
a) $\Delta U = q + W$ b) $\Delta U = q - W$ c) $\Delta U = -q + W$ d) $\Delta U = -q - W$

449. Which one of the following bonds has the highest average bond energy (kcal/mol)?
a) S = O b) C ≡ C c) C ≡ N d) N ≡ N

450. If gas, at constant temperature and pressure expands then its
a) Entropy increases and then decreases b) Internal energy increases
c) Internal energy remains the same d) Internal energy decreases

451. For a reaction, $\Delta H = 9.08$ kJ $mol^{-1}$and $\Delta S = 35.7$ $JK^{-1}mol^{-1}$. Which of the following statement is correct for the reaction?
a) Reversible and isothermal b) Reversible and exothermic
c) Spontaneous and endothermic d) Spontaneous and exothermic

452. The correct thermochemical equation is :
a) $C + O_2 \longrightarrow CO_2;\ \Delta H = -94$ kcal
b) $C + O_2 \longrightarrow CO_2;\ \Delta H = +94$ kcal

c) $C(s) + O_2(g) \longrightarrow CO_2(g);\ \Delta H = -94$ kcal
d) $C(s) + O_2(g) \longrightarrow CO_2(g);\ \Delta H = +94$ kcal

453. In which of the following reactions, standard reaction entropy change ($\Delta S°$) is positive and standard Gibbs's energy change ($\Delta G°$) decreases sharply with increasing temperature?
a) $Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s)$
b) $\frac{1}{2}C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow \frac{1}{2}CO_2(g)$
c) $C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow CO(g)$
d) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

454. The heat of formation of methane $C(s) + 2H_2(g) \rightarrow CH_4(g)$ at constant pressure is 18500 cal at 25°C. The heat of reaction at constant volume would be:
a) 19096 cal b) 18798 cal c) 18202 cal d) 17904 cal

455. Minimum work is obtained when 1 kg of … gas expanded under 500 kPa to 200 kPa pressure at 0°C.
a) Chlorine b) Oxygen c) Nitrogen d) Methane

456. The temperature of the system decreases in an
a) Adiabatic compression b) Isothermal compression
c) Isothermal expansion d) Adiabatic expansion

457. The bond of energies of H—H, Br—Br and H—Br are 433, 192 and 364 kJ $mol^{-1}$respecively. The $\Delta H°$for the reaction ; $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ is :
a) $-261$ kJ b) $+103$ kJ c) $+261$ kJ d) $-103$ kJ

458. The absolute enthalpy of neutralisation of the reaction $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$ will be
a) Greater than $-57.33$ kJ $mol^{-1}$ b) 57.33 kJ$mol^{-1}$
c) Less than $-57.33$ kJ $mol^{-1}$ d) $-57.33$ kJ $mol^{-1}$

459. We believe in the laws of thermodynamics because they are
a) Theoretical b) Derived based on mathematical analysis
c) Empirical and nobody disproved d) Mere statements

460. The enthalpy of dissolution of $BaCl_2(s)$ and $BaCl_2 \cdot 2H_2O(s)$ are $-20.6$ and 8.8 kJ per mol respectively. The enthalpy of hydration for,
$BaCl_2(s) + 2H_2O \rightarrow BaCl_2 \cdot 2H_2O(s)$ is
a) 29.4 kJ b) $-29.4$ kJ c) $-11.8$ kJ d) 38.2 kJ

461. The enthalpies of the elements in their standard states are assumed to be
a) Zero at 298 K b) Unit at 298 K
c) Zero at all temperature d) Zero at 273 K

462. The change in entropy, $\Delta S$ is positive for an endothermic reaction. If enthalpy charge $\Delta H$ occurs at the same temperature $T$, then the reaction is feasible:
a) At all temperatures b) When $\Delta H > T\Delta S$ c) When $\Delta H < T\Delta S$ d) Not feasible at all

463. 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:
a) 100 J $mol^{-1}$ $K^{-1}$ b) 10 J $mol^{-1}$ $K^{-1}$ c) 1.0 J $mol^{-1}$ $K^{-1}$ d) 0.1 J $mol^{-1}$ $K^{-1}$

464. For the reaction, $C_3H_8(g) + 5O_2 \longrightarrow 3CO_2(g) + 4H_2O(l)$ at constant temperature, $\Delta H - \Delta U$ is :
a) $+RT$ b) $-3RT$ c) $+3RT$ d) $-RT$

465. The total amount of energy in the universe is fixed, but:
a) Matter is increasing
b) Gravitation is decreasing
c) Disorder is increasing

d) Lightening is increasing

466. Which compound will absorb the maximum amount of heat when dissolved in the same amount of water? (Integral heats of solution at 25°C in kcal/mol of each solute are given in brackets):

a) $HCl(\Delta H = -17.74)$

b) $HNO_3(\Delta H = -7.85)$

c) $NH_4NO_3(\Delta H = +16.08)$

d) $NaCl(\Delta H = +1.02)$