CHEMISTRY

AAKASH INSTITUTE ENGLISH

THERMODYNAMICS

EXAMPLE

1. What kind of system does a water filled bucket represents?

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2. On what values does the state functions depend?

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3. Can adiabatic change be achieved by placing a system in thermostal?

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4. A system gives out 20 J of heat and also does 40 J of work. What is the internal energy change?

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5. An ideal gas enclosed in a cylinder fitted with a frictionless and weightless piston, pushes it outside. What would be the sign convention for the work ?

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6. Calculate the amount of work done when one mole of an ideal gas contained in a bulb of 2 L capacity at 1 atm is allowed to enter in evacuated bulb of 10 L capacity and in another case if is allowed to expand from 1 L to 5 L against a pressure of 1 atm.

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7. If water vapour is assumed to be a perfect gas, molar enthalpy change for vaporization of 1 mol of water at 1 bar and 100° C is 41 kJ mol^{-1}. Calculate the internal energy, when 1 mol of water is vapourised at one bar pressure and 100° C.

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8. A solution labelled as 1 olar NaCl is kept in the laboratory. What kind of property is this molarity, extensive or intensive ?

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9. Calculate the amount of heat required to raise the temperature of 13.5 g aluminium from 300 K to 400 K, if specific heat of aluminium is 0.9 J $(.^{\circ} k)^{-1} g^{-1}$.

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10. A swimmer coming out from a pool is covered with a film of water weighing about 18 g. how much heat must be supplied to evaporate this water at 298 K ? Calculate the internal energy of vaperization at $100^{\circ} C$.

$\Delta_{vap} H^{\Theta}$ for water at 373 K = 40.66 kJ mol^{-1}

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11. Calculate the enthalpy change where the standard heat of formation for gaseous NH_3 is -11.02 kcal/mol at 298 K. The reaction given is

$$\frac{1}{2} N_2(g) + \frac{3}{2} H_2(g) \rightarrow NH_3(g)$$

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12. If $150kJ$ of energy is needed for muscular work to walk a distance of one km, than how much of gulcose one has to consume to walk a distance of five km, provided only 30% energy is available for muscular work.The enthalpy of combustion of glucose is $3000kJmol^{-1}$

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13. Determine enthalpy change for the reaction,

$CH_{4(g)} + Cl_{2(g)} \rightarrow CH_3Cl_{(g)} + HCl_{(g)}$

Bond energies for $C-H, C-Cl, Cl-Cl, H-Cl$ are $412, 338, 242, 431kJmol^{-1}$ respectively.

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14. When 1 mole of anhydrous $CuSO_4$ is dissolved in excess of water, -66.4 kJ heat is evolved. When one mole of $CuSO_4.5H_2O$ is dissolved in water, the heat change is +11.7 kJ. Calculate enthalpy of hydration of $CuSO_4$ (anhydrous).

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15. The entropy change in the conversion of water to ice at 272 K for the system is -21.85 $JK^{-1}mol^{-1}$ and that of surrounding is +21.93 $JK^{-1}mol^{-1}$. State whether the process is spontaneous or not ?

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16. For a given reaction ΔG obtained was having positive sign convention. State whether the reaction was spontaneous or non-spontaneous.

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17. For the reaction $N_2(g) + 3H_2 \rightarrow 2NH_3(g)$

$\Delta H = -95.4kJ \text{ and } \Delta S = -198.3JK^{-1}$

Calculate the temperature at which Gibbs energy change (ΔG) is equal to zero. Predict the nature of the reaction at this temperature and above it.

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18. A monoatomic gas undergoes adiabatic process. Its volume and temperature are related as TV^P = constant. The value of p will be

$(1)\quad 1.33 \quad (2)\quad 1.67$
$(3)\quad 0.67 \quad (4)\quad 0.33$

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19. An ideal gas with pressure P, volume V and temperature T is expanded isothermally to a volume 2V and a final pressure P_i, If the same gas is expanded adiabatically to a volume 2V, the final pressure P_a. The ratio of the specific heats of the gas is 1.67. The ratio $\frac{P_a}{P_1}$ is ....

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20. Two moles of a perfect gas undergo the following processes:

a. A reversible isobaric expansion from $(1.0 atm, 20.0 L)$ to

$(1.0atm, 40.0L)$

b. A reversible isochroic change of state from $(1.0atm, 40.0L)$ to $(0.5atm, 40.0L)$

c. A reversible isothermal expansion from $(0.5atm, 40.0L) \rightarrow (1.0atm, 20.0L)$

i. Sketch with lables each of the processes on the same $P-V$ diagram.

ii. Calculate the total work (w) and the total heat change (q) involved in the above process.

iii. What will be the values of ΔH for the overall process?

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21. At $0^{\circ} C$, ice and water are in equilibrium and ΔH° = 6.00 kJ/mol for the process

$H_2O(s) \Leftrightarrow H_2O(I)$

Value of ΔS° for the conversion of ice to liquid water is

(1) $10.15JK^{-1}mol^{-1}$ (2) $17.25JK^{-1}mol^{-1}$
(3) $21.98JK^{-1}mol^{-1}$ (4) $30.50JK^{-1}mol^{-1}$

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22. The molor heat capacity of oxygen gas is given by the expression $C_v = a + bT + cT^2$ where a, b and c are constants. What will be change in internal energy of 8 g of oxygen if it is heated from 200 K to 300 K at constant volume? Assume oxygen as an ideal gas. Given a = 1.2 $JK^{-1}mol^{-1}, b = 12.8 \times 10^{-2}JK^{-2}mol^{-1}, c = 3.3 \times 10^{-7}JK^{-3}mol^{-1}$

.

(1) 1000 J (2) 950.15 J

(3) 830.5 J (4) 315.5 J

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23. A balloon filled with helium gas having pressure 2 atm was kept at room temperature (of 27° C). What will be the resulting temperature if it bursts? (Assume that change occurs reversibly)

(1) $-60^\circ C$ (2) $-45.65^\circ C$

(3) $-30.15^\circ C$ (4) $-10.5^\circ C$

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24. Find the entropy change when 90 g of H_2O at 10°C was converted into steam at 100°C.

[Given $C_P(H_2O) = 75.29JK^{-1}mol^{-1}$ and $\Delta H_{\text{vap}} = 43.932JK^{-1}mol^{-1}$]

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31. If water vapour is assumed to be a perfect gas, molar enthalpy change for vaporization of 1 mol of water at 1 bar and $100^\circ C$ is $51 kJ mol^{-1}$. Calculate the internal energy, when 1 mol of water is vapourised at one bar pressure and $100^\circ C$.

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$$\frac{1}{2}N_2(g)+\frac{3}{2}H_2(g)\to NH_3(g)$$

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37. What amount of heat will be released when(a) 0.1 mol of hydrochloric acid is neutralised by 0.1 mol of caustic soda solution (b) 0.2 mol of nitric acid is mixed with 0.2 mol of caustic soda solution?

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38. Calculate amount of heat evolved when

500 cm^3 of 0.5 hydrocloric acid is mixed with $200cm^3$ of 0.8 M NaOH solution.

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39. Determine the enthalpy change for the given reaction.

$$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCI(g)$$

Bond energies are given as follows:

$$C - H = 412kJmol^{-1}$$

$$C - CI = 338kJmol^{-1}$$

$CI - CI = 242kJmol^{-1}$

$H - CI = 431kJmol^{-1}$.

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40. When 1 mole of anhydrous $CuSO_4$ is dissolved in excess of water, -66.4 kJ heat is evolved. When one mole of $CuSO_4.5H_2O$ is dissolved in water, the heat change is +11.7 kJ. Calculate enthalpy of hydration of $CuSO_4$ (anhydrous).

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42. For a given reaction ΔG obtained was having positive sign convention. State whether the reaction was spontaneous or non-spontaneous.

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43. For the reaction

$N_2(g) + 3H_2 \rightarrow 2NH_3(g)$

$\Delta H = -85.4kJ$ and $\Delta S = -188.3Jk^{-1}$

Calculate the temperature at which Gibs energy change(ΔG) is equal to zero. Predict the nature of the reaction at this temperature and above it.

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TRY YOURSELF

1. What kind of system does a thermos flask containing coffee represents?

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2. A tree represents an ________ system.

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3. In the equation PV = nRT, how many state variables are present?

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4. Temperature is a state function or not?

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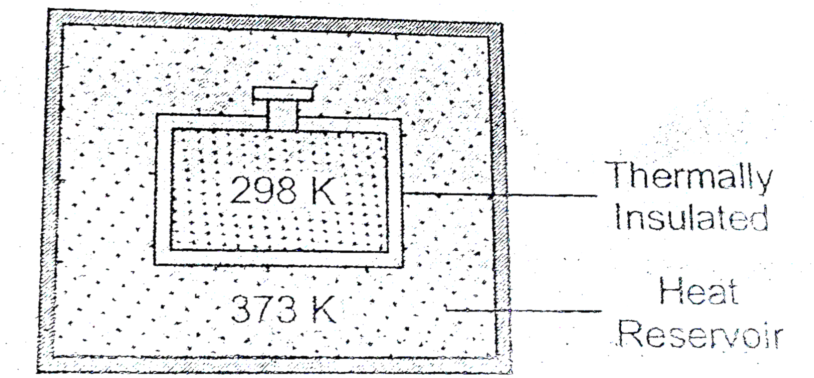
5. Consider the following figure andtell the nature of work done.



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6. A beaker containing water at 373 K is representig an open system, is placed in the room. Predict the nature of work done.

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7. 160 J of work is done on the system and at the same time 100 J of heat is given out. What is the change in the internal energy ?

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8. If change in internal energy -80 J. The work done by system is +40 J. Calculate the heat change.

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9. If the external pressure is more than internal pressure then what will be the sign convention for the work done on a cylinder fitted with a frictionless and weightless pistion containing one mole of an ideal gas?

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10. What would be the sign convention for work done on a system for a cylinder containing one mole of an ideal gas where $P_{ext} = P_{\int}$?

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11. One mole of oxygen is allowed to expand isothermally and reversibly from 5 m^3 to 10 m^3 at 300 K. Calculate the work done in expansion of the gas.

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12. How much heat would be absorbed by two litres of an ideal gas at 5 atm pressure if it expands isothermally into an evacuated flask of five litres?

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13. The heat of combustion of napthalene $\{C_{10}H_8(s)\}$ at constant volume was measured to be $-5133 kJ mol^{-1}$ at 298 K. Calculate the value of enthalpy change (Given $R = 8.314 J K^{-1} mol^{-1}$)

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14. How it is possible to find the value of ΔU and not the value of U?

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15. Out of pressure, mass, moles and volume, which is an intensive property?

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16. Pick the odd one out : (Intensive or extensive).

Refractive index, density, temperature and enthalpy.

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17. Calculate the amount of heat required to raise the temperature of 5 g of iron from $25^{\circ} C \text{to} 75^{\circ} C$. The specific heat capacity of iron is 0.45 J/g. C

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18. Calculate the weight of gold having specific heat capacity 0.13 J $(.^{\circ}C)^{-1}g^{-1}$ which is heated from $25^{\circ}C\text{to}300^{\circ}C$, where the heat absorbed is 1500 J.

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19. 90 g of water spilled out from a vessel in the room on the floor. Assuming that water vapour behaving as an ideal gas, calculate the internal energy change when the spilled water undergoes complete evaporation at $100^{\circ}C$. (Given the molar enthalpy of vaporisation of water at 1 bar and 373 K = 41 kJ mol^{-1}).

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20. One mole of carbon undergoes incomplete combustion to produce carbon monoxide, Calculate $(\Delta H - \Delta U)$ for the formation of CO at 298 K. Given R = 8.314 $JK^{-1}mol^{-1}$.

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21. The standard heat of formation of at 298 K for $CCl_4(g), H_2O(g), CO_2(g)$ and $HCI(g)$ are -25.5, -57.8, -94.1 and -22.1 kcal mol^{-1} respectively. Calculate $\Delta_r H^\Theta$ for the reaction

$CCl_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4HCl(g)$

Hint : $\Delta_r H^\Theta = \sum \Delta_f H^\Theta_{\text{Products}} - \sum \Delta_f H^\Theta_{\text{Reactants}}$

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22. Statement-1 : ΔH_f° is zero for oxygen (O_2).

And

Statement-2 : ΔH_f° for all the elements at S.T.P. is zero.

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23. An athlete is given 180 g of glucose $(C_6H_{12}O_6)$. He utilises 50% of the energy due to internal combustion in the body. In order to avoid storage of energy in the body, calculate the masss of water he would need to perspire. Given enthalpy of combustion of glucose is -2800 kJ mol^{-1} and enthalpy of evaporation of water is 44 kJ mol^{-1}

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24. A gobar gas plant produces methane and supplies to the families. If a family requires 15,000 kJ of energy per day, how many days will the quote of 10 kg will last ? $\left(\Delta_c H \text{of} CH_4 = -1665 \text{ kJ } \ mol^{-1}\right)$

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25. Calculate the heat of combustion of eithene

$CH_2 = CH_2(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(I)$

The bond energy data are given below

C = C = 619 kJ mol^{-1}

C - H = 414 kJ mol^{-1}

O = O = 499 kJ mol^{-1}

C = O = 724 kJ mol^{-1}

O - H = 460 kJ mol^{-1}

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26. Calculate the enthalpy change during the reaction :

$H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$

Given, $e_{H-H} = 435kJmol^{-1}, e_{Br-Br} = 192kJmol^{-1}$ and $e_{H-Br} = 368kJmol^{-1}$.

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27. A metal chloride dissolves endothermally and when 7.45 g of its anhydrous form are dissolved in excess of water, the amount of heat absorbed is X kJ. Calculate the enthalpy of solution if molar mass of chloride is 74.5.

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28. Integral enthalpy of solution of KCl, when 1 mole of it is dissolved in 20 mole water is +15.90 kJ. When 1 mole of it is dissolved in 200 mole water. ΔH is 18.58 kJ. Calculate enthalpy of hydration or dilution.

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29. The entropy change in the conversion of water to ice at 273 K for the system is -21.99 $JK^{-1}mol^{-1}$ and that of surrounding is +21.99 $JK^{-1}mol^{-1}$. State whether the process is spontaneous or non-spontaneous.

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30. The entropy change in the conversion of water to ice at 274 K for the system is -22.13 $JK^{-1}mol^{-1}$ and for surrounding is +22.05 $JK^{-1}mol^{-1}$. State whether the process is spontaneous or non-spontaneous.

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31. For a process $\Delta S_{\text{total}} = 0$ and $\Delta G = 0$ was obtained. What does it mean?

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32. If $\Delta G > 0$, then the nature of the process will be (spontaneous/non-spontaneous)?

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33. A certain reaction is at equilbrium at $82^{\circ} C$ and ΔH for this reaction is 21.3 kJ. What would be the value of ΔS (in $JK^{-1}mol^{1}$) for the reaction?

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34. Calculate the temperature above which the reaction of lead oxide to lead in the following reaction become spontaneous.

$PbO(s) + C(s) \rightarrow Pb(s) + CO(g)$

Given $\Delta H = 108.4 kJmol^{-1}, \Delta S = 190 JK^{-1}mol^{-1}$

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36. A tree represents an ________ system.

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37. In the equationn pV = nRT, how many state varibles are present?

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38. Temperature is a state functionn or not?

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39. What is the molarity of an aqueous solution of NaOH containing 0.5 g in $500cm^3$ of the solution ?

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40. 180 J of work is done on the system and at the same time 120 J of heat is given out. What is the change in the internal energy?

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41. If change in internal energy -90 J. The work done by system is + 50 J. Calculate the heat change.

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42. 117 gm NaCl is dissolved in 500 ml aqueous solution. Find the molarity of the solution.

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43. What would be the sign convention for work done on a system for a cylinder containing one mole of an ideal gas where $P_{ext} = P_{\int}$?

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46. The heat of combustion of napthalene $\{C_{10}H_8(s)\}$ at constant volume was measured to be $-5133kJmol^{-1}$ at 298 K. Calculate the value of enthalpy change (Given $R = 8.314JK^{-1}mol^{-1}$)

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47. Calculate the enthalpy of vaporisation per mole for ethanol. Given, $\Delta S = 109.8JK^{-1}mol^{-1}$and boiling point of ethanol is $78.5^\circ C$.

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48. Out of pressure, mass , moles and volume, which is an intensive property?

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49. The molar entropy of vaporization of acetic acid is $14.4 cal K^{-1} mol^{-1}$ at its boiling point $118^{\circ} C$. The latent heat of vaporization of acetic acid is:

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51. Calculate the weight of gold having specific heat capacity 0.13 J $(.^{\circ} C)^{-1} g^{-1}$ which is heated from $25^{\circ} C \text{to} 300^{\circ} C$, where the heat absorbed is 1500 J.

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52. 90 g of water spilled out from a vessel in the room on the floor. Assuming that water vapour behaving as an ideal gas, calculate the internal energy change when the spilled water undergoes complete evaporation at $100^{\circ} C$. (Given the molar enthalpy of vaporisation of water at 1 bar and 373 K = 41 kJ mol^{-1}).

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54. The standard heats of formation at 298K for $CCl_4(g), H_2O(g), CO_2(g)$ and $HCl(g)$ are $-25.5, \ -57.8, \ -94.1$ and -22.1 kcal mol^{-1} respectively. Calculate ΔH°_{298} for the reaction.

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C - H = 414 kJ mol^{-1}

O = O = 499 kJ mol^{-1}

C = O = 724 kJ mol^{-1}

O - H = 460 kJ mol^{-1}

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58. The net enthalpy change of a reaction is the amount of energy required to break all the bonds in reactant molecules minus amount of energy required to form all the bonds in the product molecules. What will be the enthalpy change for the following reaction ? $H_2(g)+Br_2(g)\to 2HBr(g)$. Given that, bond energy of H_2, Br_2 and HBr is $435kJmol^{-1}$, $192kJmol^{-1}$ and $368kJmol^{-1}$ respectively

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59. When 7.45 g of metal chloride dissolved in excess of water, the amount of heat absorbed is X kJ. Calculate the enthalpy of solution if molar mass of chloride is74.5.

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60. Enthalpy of solution for $BaCl_2.2H_2O$ and $BaCl_2$ are $18.8 \text{ and } -30.6kLmol^{-1}$ respectively. Calculate the enthalpy of hydration of $BaCl_2$ to $BaCl_2.2H_2O$.

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66. Calculate the temperature above which the reduction of lead oxide to lead in the following reaction become spontaneous.

$PbO(s) + C(s) \rightarrow Pb(s) + CO(g)$

Given $\Delta H = 118.4kJmol^{-1}, \Delta S = 200JK^{-1}mol^{-1}$.

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SECTION-A

1. Which one of the following is not an intensive property?

A. Pressure

B. Concentration

C. Density

D. Volume

Answer: D

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2. A system in which state variables have constant values throughout the system is called in a state of

A. Equilibrium

B. Non-equilibrium

C. Transition

D. Zero entropy

Answer: A

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3. Which of the following conditions holds good for an adiabatic process ?

A. dq lt 0

B. dq gt 0

C. dq = 0

D. dq = T

Answer: C

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4. A gas expands from 10 litres to 20 litres against a constant external pressure of 10 atm. The pressure-volume work done by the system is

A. 100 L atm

B. -100 L atm

C. 10 L atm

D. -10 L atm

Answer: B

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5. Which of the following properties is not a state function ?

A. Work

B. Internal energy

C. Enthalpy

D. Entropy

Answer: A

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6. The heat capacity at constant pressure is related to heat capacity at constant volume by the relation

A. $C_p - C_v = R$

B. $C_v - R = C_p$

C. $C_v = -C_p - R$

D. $R - C_p = C_v$

Answer: A

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7. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 L to 10 L. The ΔE for this process is (R =2cal

$\text{mol}^{-1}K^{-1}$)

A. -245.5 cal

B. 0

C. $+24$ cal

D. -24 cal

Answer: B

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8. Calculate the work done when 1 mole of a gas expands reversibly and isothermally from 5 atm to 1 atm at 300 K. [Value of log 5 = 0.6989].

A. -4015 J

B. $+4015$ J

C. Zero

D. -15 J

Answer: A

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9. The change in enthalpy that takes place when one mole of the compound is formed from its elements is called

A. Heat of formation

B. Heat of fusion

C. Heat of combustion

D. Heat of sublimation

Answer: A

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10. The change in enthalpy of a substqance when one mole of the substance is completely burnt in excess of air is called

A. Heat of sublimation

B. Heat of combustion

C. Heat of fusion

D. Both (1) & (2)

Answer: B

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11. Hess's law is used to determine

A. Heat of formation of substances which are otherwise difficult to calculate

B. Heat of transition

C. Heat of dissociation

D. All of these

Answer: D

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12. A system absorbs 300 cal of heat. The work done by the system is 200 cal. ΔU for the above change is

A. 100 cal

B. 500 cal

C. -500 cal

D. -100 cal

Answer: A

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13. In an isothermal process

A. q = 0 and ΔU = 0

B. q $\neq$ 0 and ΔU = 0

C. q = 0 and $\Delta U \neq$ 0

D. $q \neq 0$ and $\Delta U \neq 0$

Answer: B

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14. The work done during the expansion of a gas from a volume of 3 dm^3 against a constant external pressure of 3 atm is (1 L atm = 101.3 J)

A. -608 J

B. $+608$ J

C. -304 J

D. $+304$ J

Answer: A

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15. 16 g of O_2 gas at STP is expanded so that volume is doubled. Hence, work done is

A. -22.4 L atm

B. -44.8 L atm

C. -11.2 L atm

D. -5.6 L atm

Answer: C

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16. In a process, a system does 140 J of work on the surroundings and only 40 J of heat is added to the system, hence change in internal energy is

A. 180 J

B. -180 J

C. 100 J

D. -100 J

Answer: D

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17. A system absorbs 800 J of heat and system works equivalent to 900 J by expanding. The value of ΔU for the system is

A. -100 J

B. -200 J

C. -300 J

D. -400 J

Answer: A

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18. 1 mole of an ideal gas undergoes an isothermal reversible expansion form 10 atm to 1 atm at 300 K. What will be the work done ?

A. $+57.44$ J

B. -57.44 J

C. -5744 J

D. $+5744$ J

Answer: C

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19. Which among the following represents standard enthalpy of formation?

A. $2C(s)_{\text{graphite}} + 3H_2(g) + \frac{1}{2}O_2(g) \rightarrow C_2H_5OH(l)$

B. $CaO(s) + CO_2(g) \rightarrow CaCO_3$

C. $C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$

D. $Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + 3H_2O(l)$

Answer: A

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20. Which one of the following equations does not correctly respresents the first law of thermodynamics for the given process?

A. (A) Isothermal process, q = -W

B. (B) Expansion of a gas in vacuum, W = 0

C. (C) Adiabatic process, ΔU = q

D. (D) Process at constant volume, ΔU = q

Answer: C

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21. For an isothermal process

A. $\Delta H = 0$

B. $\Delta U = 0$

C. $\Delta T = 0$

D. All of these

Answer: D

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22. Heat change of a process, in which volume remains constant, is represented by

A. ΔU

B. ΔH

C. ΔG

D. Δn

Answer: A

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23. If the total enthalpy of reactants and products is H_R and H_P respectively, then for exothermic reaction

A. $H_R = H_P$

B. $H_R < H_P$

C. $H_R > H_P$

D. $H_P \geq H_R$

Answer: C

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24. In which of the following change entropy decreases?

A. Crystallization of sucrose from solution

B. Dissolving sucrose in water

C. Melting of ice

D. Vaporization of camphor

Answer: A

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25. The value of entropy of the universe is always

A. Constant

B. Decreasing

C. Increasing

D. Zero

Answer: C

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26. A reaction occurs spontaneously in forward direction if

A. (A) $T\Delta S > \Delta H$ where ΔH is positive and ΔS is negative.

B. (B) $T\Delta S = \Delta H$ where both $\Delta H \text{ and } \Delta S$ are positive

C. (C) $T\Delta S < \Delta H$ where both $\Delta H \text{ and } \Delta S$ are positive

D. (D)$T\Delta S > \Delta H$ where both $\Delta H \text{ and } \Delta S$ are positive

Answer: D

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27. For an exothermic reaction to be spontaneous (ΔS = negative)

A. Temperature must be high

B. Temperature must be zero

C. Temperature may have any magnitude

D. Temperature must be low

Answer: D

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28. The enthalpy change of a reaction does not depend on

A. State of reactants and products

B. Nature of reactants and products

C. Different intermediate reactions

D. Initial and final enthalpy change of reaction

Answer: C

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29. The free energy change for a reversible reaction at equilibrium is:

zero

small positive

small negative

large positive.

A. Zero

B. Positive

C. Negative

D. Cannot say

Answer: A

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30. In a chemical reaction, $\Delta H = 150 kJ \text{ and } \Delta S = 100 JK^{-1}$ at 300 K.

Therefore, ΔG will be

A. Zero

B. 300 kJ

C. 330 kJ

D. 120 kJ

Answer: D

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31. Pick out the correct option which represents for the work done by the system on the surroundings

A. $p_{\text{in}} > p_{\text{ex}}$

B. $p_{\text{in}} = p_{\text{ex}}$

C. $p_{\text{in}} < p_{\text{ex}}$

D. $p_{\text{ex}} \geq 1$ atm

Answer: A

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32. 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 ΔU is

A. -312 J

B. $+123$ J

C. $+312$ J

D. -213 J

Answer: D

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33. The free energy change, ΔG = 0, when

A. The reactants are completely consumed

B. A catalyst is added

C. The system is at equilibrium

D. The reactants are initially start reacting

Answer: C

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34. If an insulated container containing 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. $\Delta U = W = 0, q \neq 0$

C. $\Delta U = 0, W = q \neq 0$

D. $W = 0, \Delta U = q \neq 0$

Answer: A

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35. If the bond energies of H-H, Br-Br and H-Br are 433, 192 and 364 KJ mol^{-1} respectively , then ΔH° 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

Answer: D

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36. If one mole of ammonia and one mole of hydrogen chloride are mixed in a closed container to form ammonium chloride vapor, then

A. $\Delta H > \Delta U$

B. $\Delta H = \Delta U$

C. $\Delta H < \Delta U$

D. No relationship

Answer: C

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37. In thermodynamics, a process is called reversible when

A. Surrounding and system change into each other

B. There is no boundary between system and surrounding

C. The surrounding are always in equilibrium with the system

D. The system changes into surrounding spontaneously

Answer: C

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38. $X(g) + 2Y(g) \to 2Z(g) + 3A(g)$ The change in enthalpy at $27^{\circ}C$ is 79.5 kJ. The value of ΔU is

A. 74.5 kJ

B. 4.99 kJ

C. 79.5 kJ

D. 75.9 kJ

Answer: A

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39. In a spontaneous process the system undergoes

A. No energy change

B. Lowering of free energy

C. Lowering of entropy of universe

D. Increase in internal energy always

Answer: B

Watch Video Solution

40. A quantity of an ideal gas at $20^{\circ}C$ reversibly expands against a constant pressure of 2.0 atm from 1.0 L to 2.0 L. Calculate the work done

A. -101.3 J

B. -202.6 J

C. -844 J

D. -448J

Answer: B

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41. When the common salt dissolves in water, the entropy of the system increases. This means that the sign of ΔS is _____ and randomness of the system ______

A. Undetermined, increases

B. Positive, decreases

C. Positive, increases

D. Negative, decreases

Answer: C

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42. Pick the extensive property from the given options

A. Viscosity

B. Refractive index

C. Density

D. Heat capacity

Answer: D

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43. If a process is both endothermic and spontaneous then

A. $\Delta S > 0$

B. $\Delta S < 0$

C. $\Delta H < 0$

D. $\Delta G > 0$

Answer: A

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44. The specific heat of gas is found to be 0.075 calories at constant volume and its formula weight is 40. The atomicity of the gas would be

A. One

B. Two

C. Three

D. Four

Answer: A

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45. The standard entropies of $N_2(g), H_2(g)$ and $NH_3(g)$ are $191.5, 130.5, 192.6 JK^{-1}mol^{-1}$. The value of ΔS^0 during the formation of 1 mole of ammonia is

A. $-98.9 JK^{-1}mol^{-1}$

B. Zero

C. $+129.4 JK^{-1}mol^{-1}$

D. $-29.4 JK^{-1}mol^{-1}$

Answer: A

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SECTION-B

1. Bond energies of H - H bond is 80 kJ/mol, I - I bond is 100 kJ/mol and for H - I bond is 200 kJ/mol, the enthalpy of the reaction : $H_2(g) + I_2(g) \rightarrow 2HI(g)$ is

A. -120 kJ

B. -220 kJ

C. $+100$ kJ

D. $+120$ kJ

Answer: B

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2. The enthalpy of formation of $H_2O(l)$ is -280.70 kJ/mol and enthalpy of neutralisation of a strong acid and strong base is -56.70 kJ/mol. What is the enthalpy of formation of OH^{-} ions?

A. -22.9 kJ/mol

B. -224 kJ/mol

C. 58.7 kJ/mol

D. 214 kJ/mol

Answer: B

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3. Heat of neutralisation of a strong dibasic acid in dilute solution by NaOH is nearly :

A. -27.4 kcal/eq

B. 13.7 kcal/mol

C. -13.7kcal/eq

D. -13.7 kcal/mol

Answer: C

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4. The heat released in neutralisation of HCl and NaOH is 13.7 kcal/mol, the heat released on neutralisation of NaOH with CH_3COOH is 3.7 kcal/mol. The ΔH° of ionsiation of CH_3COOH is

A. 10.2 kcal

B. 10 kcal

C. 3.7 kcal

D. 9.5 kcal

Answer: B

Watch Video Solution

5. Which of the following reactions represents the enthalpy of formation of water?

A. $H^{+}(aq) + OH^{-}(aq) \rightarrow H_2O(l)$

B. $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$

C. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

D. $2H^{+}(aq) + 2OH^{-}(aq) \rightarrow 2H_2O(l)$

Answer: B

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6. The energy required to break 76 gm gaseous fluorine into free gaseous atom is 180 kcal at 25° C. The bond energy of F - F bond will be

A. 180 kcal

B. 90 kcal

C. 45 kcal

D. 104 kcal

Answer: B

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7. For the reaction $2HgO(s) \rightarrow 2Hg(l) + O_2(g)$

A. $\Delta H > 0 \text{ and } \Delta S < 0$

B. $\Delta H > 0 \text{ and } \Delta S > 0$

C. $\Delta H < 0 \text{ and } \Delta S < 0$

D. $\Delta H < 0 \text{ and } \Delta S > 0$

Answer: B

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8. The heat of combustion of yellow phoshphorus and red phosphorus are $-9.91 KJmol^{-1}$ and -8.78 KJ/mol respectively. The heat of transition from yellow phosphrous to red phosphorus is

A. -18.69 kJ

B. $+1.13$ kJ

C. $+18.69$ kJ

D. -1.13 kJ

Answer: D

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9. If the entropy of vaporisation of a liquid is 110 $JK^{-1}mol^{-1}$ and its enthalpy of vaporisation is 50 kJ mol^{-1}. The boiling point of the liquid is

A. 354.5 K

B. 454.5 K

C. 554.5 K

D. 445.5 K

Answer: B

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10. Which of the following represents heat of formation (ΔH_f) ?

A. $C(\text{diamond}) + O_2(g) \rightarrow CO_2(g)$

B. $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

C. $\frac{1}{2}H_2(g) + \frac{1}{2}F_2(g) \rightarrow HF(g)$

D. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Answer: C

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11. 1 mole of an ideal gas is expanded from an initial pressure of 1 bar to final pressure of 0.1 bar at constant temperature of 273 K. Predict which of the following is not true?

A. ΔE = 0

B. ΔH = 0

C. PV is constant

D. $\Delta S \leftarrow 0$

Answer: D

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12. Which of the following conditions should be satisfied for the given reaction to be spontaneous at $0^\circ C$ and 1 atm ?

$H_2O(s) \Leftrightarrow H_2O(l)$

A. $\Delta H = \Delta G$

B. $\Delta H < T\Delta S$

C. $\Delta H > T\Delta S$

D. $\Delta H = T\Delta S$

Answer: D

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13. The heat of formation of CO_2 is -407 kJ/mol. The energy required for the process $3CO_2(g) \rightarrow 3C(g) + 2O_3(g)$ is

A. Less than 1221 kJ

B. More than 1221 kJ

C. Is equal to 1221 kJ

D. Cannot be predicted

Answer: C

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14. The free energy change due to a reaction is zero when

A. The reactants are initially mixed

B. A catalyst is added

C. The system is at equilibrium

D. The reactants are completely consumed

Answer: C

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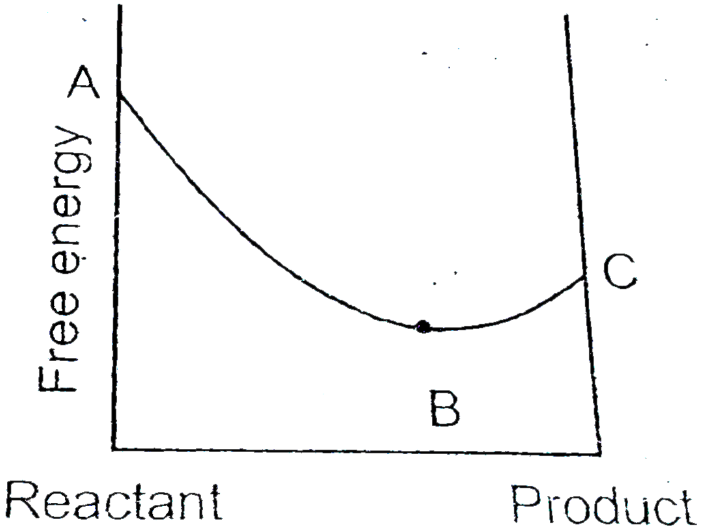
15. From the given graph



Which of the following statement is correct ?

A. The point B represents the state of equilibrium

B. The equilibrium composition strongly favours the reactant

C. From the point B formation of product is equally spontaneous as of reactant

D. From the point B formation of reactant is more spontaneous than that of product

Answer: A

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16. The heat of combustion of sucrose $C_{12}H_{22}O_{11}(s)$ at constant volume is -1348.9 kcal mol^{-1} at $25^{\circ}C$, then the heat of reaction at constant pressure, when steam is produced, is

A. -1348.9 kcal

B. 1342.344 kcal

C. 1250 kcal

D. -1250 kcal

Answer: B

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17. For the reaction, $C_7H_8(I)+9O_2(g)\rightarrow 7CO_2(g)+4H_2O(I)$, the calculated heat of reaction is 232 kJ mol^{-1} and observed heat of reaction is 50.4 kJ mol^{-1}, then the resonance energy is

A. $-182.2kJmol^{-1}$

B. $+182.2kJmol^{-1}$

C. 172 kJ mol^{-1}

D. $-172kJmol^{-1}$

Answer: A

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18. Given that ,

$A(s) \rightarrow A(l)\Delta H = x$

$A(l) \rightarrow A(g), \Delta H = y$

The heat of sublimation of A will be :

A. x - y

B. x + y

C. x or y

D. $-x+y$

Answer: B

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19. 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 $-100kJmol^{-1}$, what is the bond enthalpy of A_2 ?

A. 400 kJ mol^{-1}

B. 200 kJ mol^{-1}

C. 300 kJ mol^{-1}

D. 100 kJ mol^{-1}

Answer: A

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20. One mole of a perfect gas expands isothermally to ten times its original volume. The change in entropy is

A. 0.1 R

B. 10 R

C. 2 R

D. 2.303 R

Answer: D

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SECTION-C

1. Which of the following is/are extensive properties?

A. Entropy

B. Density

C. Enthalpy

D. Boiling point

Answer: A::C

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2. At 25° and 1 atm, which one(s) of the following has nonzero $\Delta H^{\circ}._{f}$?

A. Fe

B. O

C. C(diamond)

D. Ne

Answer: B::C

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3. The factors which influence the heat of reaction are

A. Physical state of reactants and products

B. The temperature of the reaction

C. The method by which the final products are obtained

D. Whether the reaction is carried out at constant pressure or constant temperature

Answer: A::B::D

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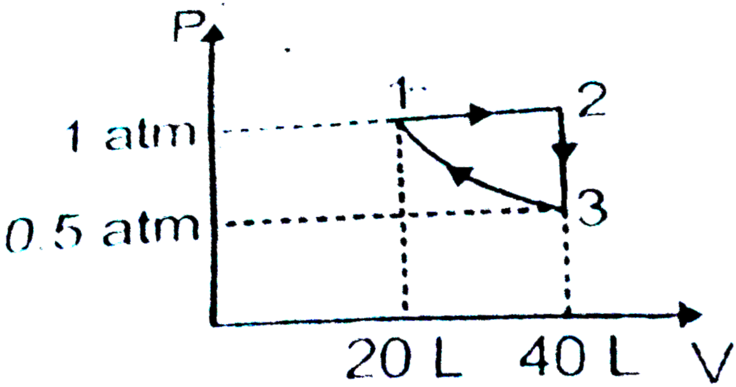
4. For the given graph, which parameters will be zero?



A. ΔQ

B. ΔH

C. ΔU

D. ΔS

Answer: B::C::D

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5. Which of the following is/are state function?

A. Enthalpy

B. Heat

C. Entropy

D. Gibb's free energy(G)

Answer: A::C::D

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6. Enthalpy of neutralization of strong acid with strong base is 13.7 kcal. When an unknown acid (1 eq) is neutralizedwith (1 eq.) strong base, the enthalpy change is 10.7 kcal which of the following statements is/are correct regarding unknown acid?

A. Unknown acid is strong acid

B. Unknown acid is weak acid

C. 3.0 kcal heat utilised to dissociate the unknown acid

D. 10.7 kcal heat utilised to dissociate unknown acid

Answer: B::C

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7. Which of the following statements is/are correct?

A. For spontaneous process, ΔG must be negative

B. At equilibrium, ΔG = 0

C. At equilibrium, $\Delta G^\circ = 0$

D. AT equilibrium, $\Delta G^\circ = -2.303RT\log K_P$

Answer: A::B::D

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8. In which case of mixing of strong acid and strong base each of 1 N concentration temperature increase of solution will be same (assume heat evolved in neutralisation is only used up to increase the temperature of solution)?

A. 20 ml acid and 30 ml alkali

B. 10 ml acid and 10 ml alkali

C. 35 ml acid and 15 ml alkali

D. 50 ml acid and 50 ml alkali

Answer: B::D

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9. A mole of steam is condensed at 100° C, the water is cooled to 0° C and frozen to ice . What is the difference in entropies of the steam and ice? The heat of vaporization and fusion are $540 cal \quad gm^{-1}$ and $80 cal \quad gm^{-1}$ respectively . Use the average heat capacity of liquild water as $1 cal \quad gm^{-1} degree^{-1}$.

a. Entropy change during the condensation of steam is $-26.06 cal / ^\circ C$

b. Entropy change during cooling of water from

$100^{\circ} C \text{to} 0^{\circ} C \text{is} - 5.62 cal / ^{\circ} C$

c. Entropy change during freezing of water at $0^{\circ} C \text{is} - 5.27 cal / ^{\circ} C$

d. Total entropy changwe is $-36.95 cal / ^{\circ} C$

A. Entropy change during the condensation of steam is $-26.06 cal / ^{\circ} C$

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C. Entropy change during freezing of water at $0^{\circ} C \text{is} - 5.27 cal / ^{\circ} C$

D. Total entropy changwe is $-36.95 cal / ^{\circ} C$

Answer: A::B::C::D

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10. For a diatomic gas, which options is/are correct?

A. $\gamma = 1.40$

B. $C_P = \frac{7R}{2}$

C. $C_v = \frac{5R}{2}$

D. $\gamma = 1.67$

Answer: A::B::C

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11. When the gas is ideal and process is isothermal, then

A. $P_1V_1 = P_2V_2$

B. $\Delta U = 0$

C. $\Delta W = 0$

D. $\Delta H_1 = \Delta H_2$

Answer: A::B::D

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12. Which of the following relation is/are correct?

A. $\Delta G = \Delta H - T\Delta S$

B. $\Delta G = \Delta H + T\left[\frac{\delta(\Delta G)}{\delta T}\right]_P$

C. $\Delta G = \Delta H + T\Delta S$

D. $\Delta G = \Delta H + \Delta nRT$

Answer: A::B

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13. Heat evolved during the combustion of 32 gm methanol is a bomb calorimeter was determined to be 470 kcal/mol at 25°C. The value of Δu of the reaction at the same temperature is

A. -335.24 kcal

B. -669.28kcal

C. -470 kcal/mol

D. -196.5×10^4 J

Answer: C::D

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SECTION-D

1. Entropy is a measure of randomess of system. When a liquid is converted to the vapour state entropy of the system increases. Entropy in the phase transformation is calculated using $\Delta S = \dfrac{\Delta H}{T}$ but in reversible adiabatic process ΔS will be zero. The rise in temperature in isobaric or isochoric process increases the randomness of system, which is given by

$$\Delta S = 2.303 \text{ n C} \log\left(\frac{T_2}{T_1}\right)$$

$$C = C_P \text{ or } C_V$$

The temperature at whicgh liquid H_2Owill be in equrilibrium with its vapour is (ΔH and ΔS for vapourisation are 50 kJ mol^{-1} and 0.15 kJ $mol^{-1}K^{-1}$)

A. $77.30^\circ C$

B. $60.33^\circ C$

C. $50^\circ C$

D. $100^\circ C$

Answer: B

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2. Entropy is a measure of randomess of system. When a liquid is converted to the vapour state entropy of the system increases. Entropy in the phase transformation is calculated using $\Delta S = \frac{\Delta H}{T}$ but in reversible adiabatic process ΔS will be zero. The rise in temperature in isobaric or isochoric process increases the randomness of system, which is given by

$$\Delta S = 2.303 \text{ n C} \log\left(\frac{T_2}{T_1}\right)$$

$$C = C_P \text{ or } C_V$$

The change in entropy when 1 mole O_2 gas expands isothermally and reversibly from an initial volume 1 litre to a final volume 100 litre at $27^{\circ}C$

A. $20.5JK^{-1(mol^{-1}}$

B. $38.29JK^{-1}mol^{-1}$

C. $42.50JK^{-1}mol^{-1}$

D. $50.65JK^{-1}mol^{-1}$

Answer: B

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3. Entropy is a measure of randomess of system. When a liquid is converted to the vapour state entropy of the system increases. Entropy in the phase transformation is calculated using $\Delta S = \frac{\Delta H}{T}$ but in reversible adiabatic process ΔS will be zero. The rise in temperature in isobaric or isochoric process increases the randomness of system, which is given by

$$\Delta S = 2.303 \text{ n C} \log\left(\frac{T_2}{T_1}\right)$$

$C = C_P$ or C_V

Entropy change in a reversible adiabatic process is

A. Zero

B. Always positive

C. Always negative

D. Sometimes positive and sometimes negative

Answer: A

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4. Heat of reaction is defined as the amount of heat absorbed or evolved at a given temperaturewhen the reactants have combined to form the products is represented by a balanced chemcial equation. If the heat is denofed by q then the numerical value of q depends on the manner in which the reaction is performed for the two methods of conducting chemical reactions in calorimeters.

Constant volume W = 0 and $q_v = \Delta E$ Bomb calorimeter

Constant pressure W = - V ΔP, therefore $q_P = \Delta E + P \Delta V rar (V. \Delta P)$

The heat capacity of a bomb calorimeter is 300 JK When 0.16 gm of methane was burnt in this calorimeter the temperature rose by 3°C. The value of ΔU per mole will be

a. 100 KJ

b. 90 KJ

c. 900 KJ

d. 48KJ

A. 100 kJ

B. 90 kJ

C. 900 kJ

D. 48 kJ

Answer: B

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5. Heat of reaction is defined as the amount of heat absorbed or evolved at a given temperaturewhen the reactants have combined to form the products is represented by a balanced chemcial equation. If the heat is denofed by q then the numerical value of q depends on the manner in which the reaction is performed for the two methods of conducting chemical reactions in calorimeters.

Constant volume W = 0 and $q_v = \Delta E$ Bomb calorimeter

Constant pressure W = - V ΔP, therefore $q_P = \Delta E + P \Delta V rar (V . \Delta P)$

When maltose $C_{12}H_{22}O_{11}(s)$ burns in a calorimetric bomb at 298 K yielding carbon dioxide and water, the heat of combustion is -1350 kcal/mol, the heat of combustion of maltose at constant pressure will be

A. -2650 kcal/mol

B. -675 kcal/mol

C. -1350 kcal/mol

D. -1100 kcal/mol

Answer: C

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6. Heat of reaction is defined as the amount of heat absorbed or evolved at a given temperaturewhen the reactants have combined to form the products is represented by a balanced chemcial equation. If the heat is denofed by q then the numerical value of q depends on the manner in which the reaction is performed for the two methods of conducting chemical reactions in calorimeters.

Constant volume W = 0 and $q_v = \Delta E$ Bomb calorimeter

Constant pressure W = - V ΔP, therefore $q_P = \Delta E + P\Delta V rar (V. \Delta P)$

The heat of combustion of maltose at constant volume in the above question if water vapour are not condensed

A. -1350 kcal/mol

B. -1343 kcal/mol

C. -1370 kcal/mol

D. -1400 kcal/mol

Answer: B

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7. In a fuel celll, methanol is used as a fuel and O_2 is used as oxidizer. The standard enthalpy of combustion of methanol is -726 kJ mol^{-1}. The standard free energies of formation of $CH_3OH(I), CO_2(g)$ and $H_2O(I)$ are -166.3, -394.4 and -237.1 kJ mol^{-1} respectively.

The standard free energy change of the reaction will be

A. -597.8 kJ mol^{-1}

B. -298.9 kJ mol^{-1}

C. -465.2 kJ mol^{-1}

D. -702.3 kJ mol^{-1}

Answer: D

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

$$CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow CO_2((g)) + 2H_2O_{(l)}$$

At $298K$ standard Gibb's energies of formation for $CH_3OH(l), H_2O(l)$ and $CO_2(g)$ are $-166.2, \ -237.2$ and $-394.4kJmol^{-1}$ respectively. If standard enthalpy of combustion of methanol is $-726kJmol^{-1}$, efficiency of the fuel cell will be :

A. 96.7%

B. 66.2%

C. 41.3%

D. 85.1%

Answer: A

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9. In a fuel celll, methanol is used as a fuel and O_2 is used as oxidizer. The standard enthalpy of combustion of methanol is -726 kJ mol^{-1}. The standard free energies of formation of $CH_3OH(I), CO_2(g)$ and $H_2O(I)$ are -166.3, -394.4 and -237.1 kJ mol^{-1} respectively.

The standard free energy change of the reaction will be

A. -727.24 kJ mol^{-1}

B. -724.76 kJ mol^{-1}

C. -728.48 kJ mol^{-1}

D. -723.42 kJ mol^{-1}

Answer: B

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SECTION-E

1. Statement-1 : Chemical equation $H^+(aq) + OH^-(aq) \rightarrow H_2O(I), \Delta H = -X$ kJ represents the enthalpy of formation of water

And

Statement-2 : $\Delta H_{\text{neutralisation}}$ of strong acid and strong base is constant.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: D

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2. Statement-1 : In a cyclic process, both ΔH and ΔU are zero.

And

Statement-2 : ΔH and ΔU are path dependent functions.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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3. Statement-1 : Enthalpy (H) and entropy (S) both are extensive properties.

And

Statement-2 : Both are independent of mass.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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4. Statement-1 : Work done in isothermal reversible process is more than irreversible process.

And

Statement-2 : Irreversible process is an infinitesimally slow process.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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5. Statement-1 : ΔH_f° is zero for oxygen (O_2).

And

Statement-2 : ΔH_f° for all the elements at S.T.P. is zero.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: C

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6. Statement-1 : ΔH and ΔU are the same for the reaction $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$

And

Statement-2 : All reactants and products are in gaseous form.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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7. Statement-1 : All the exothermic reactions are spontaneous.

And

Statement-2 : For a spontaneous reaction, ΔG must be negative.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: D

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8. Statement-1 : Thermochemistry involves the calculation of heat change through balanced reactions.

And

Statement-2 : Enthalpy is a state function.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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9. Statement-1 : Entropy of egg increases after boiling.

And

Statement-2 : As boiling causes the denaturation of proteins.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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10. Statement-1 : If same amounts are considered CO_2 requires more heat than O_2, for the same rise in temperature.

And

Statement-2 : CO_2 being triatomic has higher heat capacity than O_2

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True, Statement-2 is Not a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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SECTION-F

1. Match the following

	Column-I		Column-II
(A)	Isothermal process	(p)	Temperature changes
(B)	Isobaric process	(q)	Pressure changes
(C)	Isochoric process	(r)	Volume change
(D)	Cyclic process	(s)	Initial and final states are same

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2. Match the following

	Column-I (Enthalpy change in kcal)		Column-II (Neutralisation)
(A)	<13.7 kcal	(p)	$\underset{(1\text{ mol})}{HCI} + \underset{(1\text{ mol})}{NaOH}$
(B)	$=13.7$ kcal	(q)	$\underset{(1\text{ mol})}{HF} + \underset{(1\text{ mol})}{NaOH}$
(C)	gt 13.7 kcal	(r)	$\underset{(1\text{ mol})}{NH_4OH} + \underset{(1\text{ mol})}{HCI}$
(D)	$= 27.4$ kcal	(s)	$\underset{(2\text{ mol})}{NaOH} + \underset{(1\text{ mol})}{H_2SO_4}$
		(t)	$\underset{(1\text{ mol})}{NaOH} + \underset{(1\text{ mol})}{CH_3COOH}$

Assume heat of neutralisation of strong acid with strong base is 13.7 kcal.

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3. Match the following

	Column-I		Column-II
(A)	Enthalpy	(p)	Extensive property
(B)	Entropy	(q)	H - TS
(C)	Free energy	(r)	E + PV
(D)	Pressure	(s)	Intensive property

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SECTION-G

1. The maximum work done when pressure of n moles of H_2 was reduced from 20 atm to 1 atm at constant temperature of 273 K is found to be 8180 calories. What is the value of n?

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2. One mole of an ideal monoatomic gas expands reversibly and adiabatically from a volume of x litre to 14 litre at 27°C. Then value of x will be [Given, final temperature 189 K and C_V = 3/2 R].

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3. For a reversible reaction $A \Leftrightarrow B$. Find $\frac{\log_{10} K}{10}$ at 2727° C temperature

Given

$\Delta_r H^0$ = - 54.07 kJ mol^{-1}

$\Delta_r S^0$ = 10 JK^{-1}

R = 8.314 $JK^{-1}mol^{-1}$

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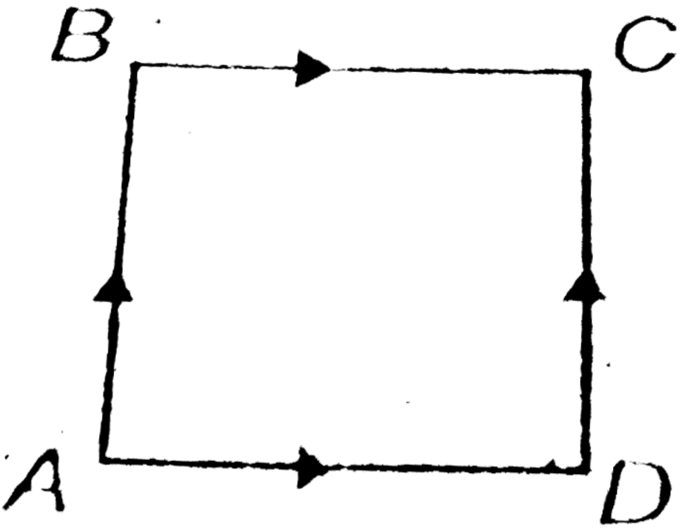
4. When a system is taken from A to C through path ABC, 10 J of heat flows to the system and 4 J of work is done by the system.



How much heat flows into the system in path ADC, if the work done by the system is 3 J ?

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5. The chemical reaction : A $\rightarrow$ P, ΔH° = 2.8 kJ is spontaneous only above 400 K. Therefore ΔS of reaction must be at least $\left(JK^{-1}\right)$.

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SECTION-H

1. Statement-1 : Neutralisation reaction is an Endothermic Process.

Statement-2 : Standard Enthalpy of Neutralisation for different pairs of strong acid and strong base are different.

Statement-3 : Standard Enthalpy of Neutralisation for a pair of strong acid and strong base is higher than that of weak acid and weak base.

A. F F T

B. F T T

C. T F T

D. F T F

Answer: A

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2. Statement-1 : Entropy of all elements is zero at zero Kelvin.

Statement-2 : Standard entropy of all elements is greater than zero.

Statement-3 : Entropy of all elements and compounds decreases with decrease of temperature and becomes zero at absolute zero temperature.

A. F F F

B. T T T

C. T F F

D. F T F

Answer: B

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3. Statement-1 : The third law of thermodynamics implies that absolute zero cannot be reached.

Statement-2 : ΔG° for an ideal gas reaction is a function of temperature.

Statement-3 : The adiabatic expansion of a gas into a vacuum is spontaneous.

A. F F F

B. T T T

C. T F F

D. F T F

Answer: B

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SECTION-I

1. Calculate enthalpy change of the following reaction :

$CH_2 = CH_2(g) + H_2(g) \rightarrow CH_3 - CH_3(g)$

The bond energy of C - H, C - C, C = C, H - H are $414, 347, 615 \text{ and } 436 kJ$ mol^{-1} respectively.

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2. At 300 K, 4 gm calcium is dissolved in hydrochloric acid in an open vessel at the atmoshphere pressure 0.821 atm. Calculate work done by the system.

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3. At constant temperature 60% AB dissociates into A_2 and B_2, then the equilibrium constant for $2AB(g) \rightleftharpoons A_2(g) + B_2(g)$ is ?

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4. If x gm of steam at 100° C is mixed with 5x gm of ice at $0^\circ C$, calculate the final temperature of resultiong mixture. The heat of vapourisation and fusion are 540 cal gm^{-1} and 80 cal gm^{-1} respectively.

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5. Calculate $\Delta H^{\circ}._{f}$ for chloride ion from the following data :

$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCI(g), \Delta H^{\circ}._{f}$ = -92.4 kJ

$HCI(g) + nH_2O \rightarrow H^{+}(aq) + CI^{-}(aq), \Delta H^{\circ}$ = - 74.8 kJ

$\Delta H^{\circ}._{f}\ H^{+}(aq)$ = 0.0 kJ

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6. The standard molar enthalpies of formation of cyclohexane (l) and benzene (l) at $25^{\circ}C$ are -156 and $+49kJmol^{-1}$, respectively. The standard enthaly of hydrogenation of cyclohenxene (l) at $25^{\circ}C$ is $-119kJmol^{-1}$ Use this data to estimate the magnitude of the resonance enegry of benzene.

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7. The specific heat at constant volume for a gas is 0.075 cal/g and at constant pressure is 0.125 cal/g. Calculate

(i) Molecular weight of gas

(ii) Atomicity of gas

(iii) Number of atoms of gas in its 1 mole

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8. The enthalpy change involved in the oxidation of glucose is $-2880kJmol^{-1}$. Twenty-five per cent of this enegry is avaible for muscular work. If $100kJ$ of muscular work is needed to walk one kilometre, what is the maximum distance that a person will be able to walk after eating $120g$ of glucose.

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9. Calculate standard heat of formation of CS_2. Given that standard heat of combustion of C, S and CS_2 are $-393.3, -293.72$ and $-1108.76kJmol^{-1}$.

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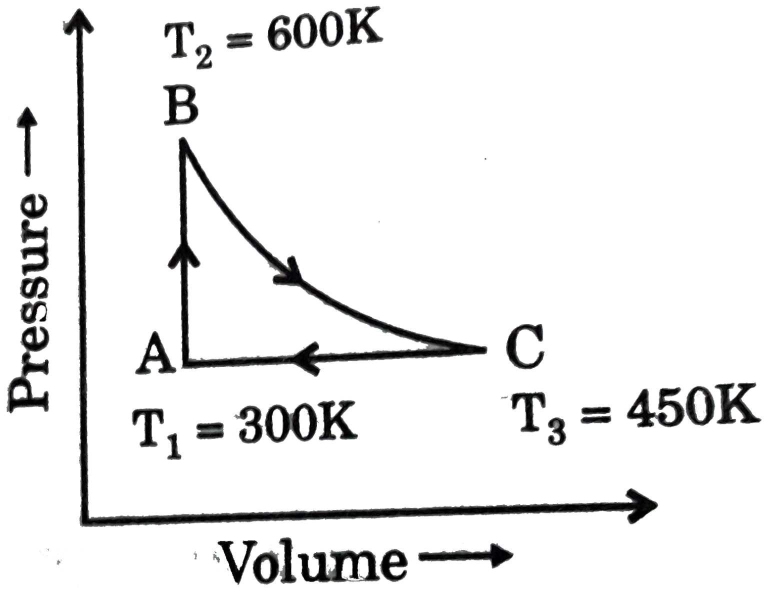
SECTION-J

1. A heat engine carries one mole of an ideal monoatomic gas around the cycle as shown in the figure, the amount of heat added in the process AB and heat removed in the process CA are :



A. $q_{AB} = 750R$ and $q_{CA} = -450R$

B. $q_{AB} = 650R$ and $q_{CA} = -350R$

C. $q_{AB} = 450R$ and $q_{CA} = -375R$

D. $q_{AB} = 650R$ and $q_{CA} = -450R$

Answer: C

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2. Calculate the average molar heat capacity at constant volume of a mixture containing 2 moles of monoatomic and 3 moles of diatomic ideal gas.

A. R

B. 2.1 R

C. 3.2 R

D. 4 R

Answer: B

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3. What is the change in entropy when 2.5 mole of water is heated from $27^\circ C$ to $87^\circ C$?

Assume that the heat capacity is constant $\left((C_p)_m(H_2O) = 4.2J/g = k, \ln(1.2) = 0.18\right)$

A. (A)16.4 JK^{-1}

B. (B) 34.02 JK^{-1}

C. (C) 2.89 JK^{-1}

D. (D) 18.2 JK^{-1}

Answer: B

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4. Which amog the following is most soluble in water?

A. $\begin{array}{lll} \text{Compound} & \Delta_H(\text{hydration})\left(KJmol^{-1}\right) & \Delta H_{\text{lattice}}(K) \\ A & -400 & +500 \end{array}$

B. $\begin{array}{lll} \text{Compound} & \Delta_H(\text{hydration})\left(KJmol^{-1}\right) & \Delta H_{\text{lattice}}(K) \\ B & -300 & +650 \end{array}$

C. $\begin{array}{lll} \text{Compound} & \Delta_H(\text{hydration})\left(KJmol^{-1}\right) & \Delta H_{\text{lattice}}(K) \\ C & +200 & +150 \end{array}$

D. $\begin{array}{lll} \text{Compound} & \Delta_H(\text{hydration})\left(KJmol^{-1}\right) & \Delta H_{\text{lattice}}(K) \\ D & -100 & +250 \end{array}$

Answer: C

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5. A hungry man weighing 80 kg take quickly 20 g lunck, and then climbs up a mountain making it to a height of 200 m. If 60% of food energy was wasted as heat and the rest was used as climbing work. The fuel intake could have been any one of the following with given enthalpy of combustion?

A. Glucose 16 kJ/g

B. Wheat bread 20 kJ/g

C. Fructose syrup 13 kg/g

D. Olive oil 35 kg/g

Answer: B

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6. According to second law of thermodynamics

A. Heat can't flow spontaneously from a reservoir at lower temperature to a reservoir at higher temperature

B. All spontaneous process leads to increase in entropy of universe

C. Melting a solid increase entropy, therefore a spontaneous process

D. All of these

Answer: D

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7. Consider the reacton

$$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g) + 200kJ$$

The signs of $\Delta S, \Delta H$ and ΔG respectively are

A. $+, \ -, \ -$

B. $-, \ +, \ +$

C. $-, \ -, \ -$

D. $-, \ +, \ -$

Answer: D

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Exercise

1. Which of the following is an example of open system?

A. Human body

B. The earth

C. Pond

D. All of these

Answer: D

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2. Which of the following is not a state function?

A. H

B. U

C. q

D. G

Answer: C

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3. Which of the following is intensive property?

A. Temperature

B. Heat

C. Mass

D. Volume

Answer: A

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4. Closed system can exchage (with surroundings)

A. Heat

B. Matter

C. Heat and matter

D. Neither heat nor matter

Answer: A

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5. System and surroundings together constitute

A. The earth

B. The solar system

C. Galaxy

D. Universe

Answer: D

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6. Define State of a system.

A. Pressure

B. Volume

C. Number of mole

D. All of these

Answer: D

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7. Which of the following is true about isolated system?

A. Heat passes into or out of the system

B. Matter enters or leaves the system

C. Work can be done on the system

D. All are correct

Answer: C

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8. Thermodynamics deals with

A. Macroscopic properties

B. Microscopic properties

C. Both Macroscopic & microscopic properties

D. Neither macroscopic nor microscopic properties

Answer: A

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9. The thermodynamic process in which temeprature remains constant is

A. Adiabatic process

B. Isochoric process

C. Isobaric process

D. Isothermal process

Answer: D

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10. Which of the following is a state function?

A. q + w

B. Entropy

C. Free Energy

D. All of these

Answer: D

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11. $\Delta E \text{ and } \Delta H$ both are zero in

A. Isobaric process

B. Adiabatic process

C. Isochoric process

D. Cyclic process

Answer: D

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12. The work done in open vessel at 300 K, when 56 g iron reacts with dilute HCl is

A. 600 cal

B. 300 cal

C. 150 cal

D. 100 cal

Answer: A

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13. Work done in reversible isothermal expansion is given by

A. $-2.303RT\frac{\log V_2}{V_1}$

B. $n\frac{R}{\lambda-1}(T_2-T_1)$

C. $2.303RT\frac{\log V_2}{V_1}$

D. None of these

Answer: A

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14. When a gas undergoes adiabatic expansion, it gets cooles. This is because

A. It is an exothermic process

B. It is an endothermic process

C. Internal energy of the system decreases

D. Ideal gas becomes a real gas

Answer: C

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15. Which of the following is correct expression for 1st law of thermodynamics under adiabatic condition?

A. $\Delta U = Q + W$

B. $\Delta U = Q - W$

C. $Q = \ - W$

D. $\Delta U = W$

Answer: D

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16. Expansion of a perfect gas into vaccum is related with

A. $\Delta H = 0$

B. $q = 0$

C. $W = 0$

D. All of these

Answer: D

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17. The following reactions carried in open vessel. The reaction for which $\Delta H = \Delta U$ will be

A. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

B. $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

C. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

D. $H_2(g) + I_2(g) \rightarrow 2HI(g)$

Answer: D

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18. For the reaction $\frac{1}{8}S_8(s) + \frac{3}{2}O_2(g) \rightarrow SO_3(g),$ the difference of heat change at constant pressure and constant volume at $27^\circ C$ will be.

A. $+150R$

B. $-150R$

C. $+450R$

D. $-450R$

Answer: B

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19. Choose the correct statement(s)

A. Work done by the system is taken as negative

B. In expansion , there is work done by the system

C. $W_{\text{reversible}} > W_{\text{irreversible}}.$

D. All of these

Answer: D

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20. Under which of the following condition $\Delta H = \Delta E$?

A. When a process is carried out in a closed vessel

B. When reaction involves only solids and liquids

C. When $\Delta n_g = 0$

D. All of these

Answer: D

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21. What is the change in internal energy if 10 J of heat is given to system at constant pressure and 20 J of work is done by the system?

A. 10 J

B. 30 J

C. $-10J$

D. $-30J$

Answer: C

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22. For isothermal expansion , which is true?

A. $\Delta P = 0$

B. $\Delta S = 0$

C. $\Delta G = 0$

D. $\Delta U = 0$

Answer: D

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23. For hydrogen gas $C_p - C_v = a$ and for oxygen gas $C_p - C_v = b$. So, the relation between a and b is given by

A. a = 16 b

B. 16a = b

C. a = 4b

D. a = b

Answer: D

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24. $550 kJ \text{cycle}^{-1}$ work is done by 1 mol of an ideal gas in a cyclic process. The amount of heat absorbed by the system in one cycle is

A. 550 kJ

B. $-550 kJ$

C. 1100 kJ

D. Zero

Answer: A

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25. An ideal gas undergoing expansion in vaccum shows

A. $\Delta E = 0$

B. $w = 0$

C. $q = 0$

D. All of these

Answer: D

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26. $1gH_2$ gas STP is expanded so that the volume is doubled. Hence, work done is

A. 260 cal

B. 180 cal

C. 130 cal

D. 270 cal

Answer: D

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27. An ideal gas is kept in a 5 litre cylinder at a pressure of 15 atm. In 30 minutes the gas is allowed to enter slowly into an evacuated vessel of 550 L capacity. Total work done during the process of expansion is

A. 2500 L atm

B. 7500 L atm

C. 7425 L atm

D. 0

Answer: D

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28. An ideal gas is allowed to expand from 5 L to 15 L once rapidly and once very slowly. The magnitude of work done in two processes are W_1 and W_2, they are related as

A. $W_1 = W_2$

B. $W_1 > W_2$

C. $W_1 < W_2$

D. Data is insufficient

Answer: C

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29. Correct statement about $heat$ and $w \text{ or } k$ is that

A. Heat appears at surface only and work in bulk

B. Heat appears in bulk and work only at surface

C. Both heat and work appear in bulk of sysem

D. Both heat and work appear on surface only

Answer: D

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30. For one mole of a diatomic gas γ is equal to

A. $\frac{3}{5}$

B. $\frac{5}{3}$

C. $\frac{7}{5}$

D. $\frac{8}{6}$

Answer: C

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31. The enthalpy of reaction is maximum in which of the following reaction?

A. $NaOH + HCI \rightarrow NaCI + H_2O$

B. $NaOH + HF \rightarrow NaF + H_2O$

C. $NaOH + HBr \rightarrow NaBr + H_2O$

D. All have same value

Answer: B

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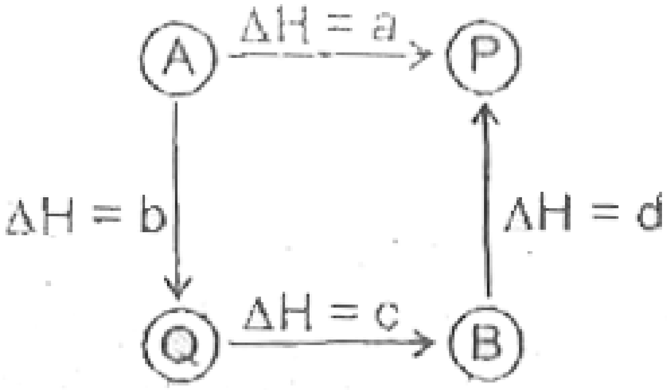

32.

On the basis of Hess's law of constant heat summation, choose the correct relation:

A. $b = a - cd + c$

B. $c = a - b + d$

C. $d = a + b + c$

D. $a - c = b + d$

Answer: D

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33. In which of the following $\Delta H = \Delta U$?

A. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

B. $C(s) + O_2(g) \rightarrow CO_2(g)$

C. $PCI_5(g) \rightarrow PCI_3(g) + CI_2(g)$

D. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

Answer: B

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

A. CH_4

B. C_2H_4

C. C_2H_6

D. All of these

Answer: B

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

A. $P > Q > R > S$

B. $P > S > R > Q$

C. $S > R > Q > P$

D. $S > Q > R > P$

Answer: B

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36. Heat of neutralisation of $NaOH$ and HCl is $-57.46kJ/$ equivalent. The heat of ionisation of water in kJ/mol is :

A. -57.46

B. $+57.46$

C. -114.92

D. $+114.92$

Answer: B

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37. Bond energy of $N-H, H-H$ and $N\equiv N$ are a, b, c respectively. The ΔH for the reaction,

$2NH_3[g] \rightarrow N_2[g] + 3H_2[g]$ is :

A. $6a-3b-c$

B. $6a+3b+c$

C. $a + 6b - c$

D. $6a + b - 3c$

Answer: A

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38. At $27^\circ C$, the combustion of ethane takes place according to the reaction $C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

$\Delta E - \Delta H$ for this reaction at $27^\circ C$ will be

A. $+1347.1J$

B. $-1247.1J$

C. -$6235.5J$

D. $+6235.5J$

Answer: D

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39. For the reaction

$PCI_3(g) + CI_2(g) \to PCI_5(g), \Delta H = -xkJ$

If the $\Delta H_f^\circ \mathrm{PCI_3} is - ykJ,$ what is $\Delta H_f^\circ PCI_5$?

A. $(x - y)kJ$

B. $(y - x)kJ$

C. $-(x + y)kJ$

D. $(x + y)kJ$

Answer: C

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40. Heat of which of the following reaction gives enthalpy of formation directly?

A. $H_2 + I_2(g) \to 2HI_g$

B. $N_2(G) + 3H_2(g) \rightarrow 2NH_3(g)$

C. $C_{gra\phi te} + 2H_2(g) \rightarrow CH_4(g)$

D. All of these

Answer: C

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41. When ΔH and $T\Delta S$ both are negative , then for spontaneous process which option is true?

A. $\Delta H > T\delta S$

B. $\Delta H < T\delta S$

C. $\Delta H = T\delta S$

D. $\Delta H = \Delta U$

Answer: A

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42. Which of the following relation is false?

A. $\Delta G = \Delta H - T\Delta S$

B. $\Delta S = q + T$

C. $\Delta H = \Delta U + \Delta n_g RT$

D. $\Delta H = \Delta U + P\Delta V$

Answer: B

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43. In a reversible process, the value of $\Delta S_{sys} + \Delta S_{surr} is$

A. > 0

B. < 0

C. $= 0$

D. All of these

Answer: C

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44. A boiled egg shows a/an .... In entropy

A. Increase

B. Decrease

C. No change

D. None of these

Answer: A

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45. The ΔG in the process of melting of Ice at $-15^{\circ}C$ is

A. $\Delta G < 0$

B. $\Delta G > 0$

C. $\Delta G = 0$

D. All of these

Answer: B

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46. The spontaneous nature of a reaction is impossible if

A. $\Delta H = +ve, \Delta S = +ve$

B. $\Delta H = -ve, \Delta S = -ve$

C. $\Delta H = -ve, \Delta S = +ve$

D. $\Delta H = +ve, \Delta S = -ve$

Answer: D

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47. ΔG° of reversible reaction at its equilbrium is

A. Positive

B. Negative

C. Always zero

D. May be(1) or (2)

Answer: D

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48. Latent heat of fusion of ice is $0.333kJg^{-1}$. The increase in entropy when 1 mole water melts at $0^{\circ}C$ will be

A. $21.96kJ^{-1}mol^{-1}$

B. $21.98kcalK^{-1}mol^{-1}$

C. $21.96JK^{-1}mol^{-1}$

D. $21.98calK^{-1}mol^{-1}$

Answer: C

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49. The value for ΔH_{vap} and ΔS_{vap} for ethanol are respectively $38.594 kJmol^{-1}$ and $109.8 JK^{-1}mol^{-1}$. The boiling point of ethanol will be

A. $78.5K$

B. $431.5K$

C. $351.5K$

D. $331.5K$

Answer: C

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50. 3RD LAW OF THERMODYNAMICS

A. Entropy change

B. Enthalpy

C. Free Energy

D. Absolute entropy

Answer: D

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ASSIGNMENT (Section - A) Objective Type Questions

1. Tea placed in thermos flask is an example of

A. Open system

B. Close system

C. Isolated system

D. It can't act as system

Answer: C

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2. Gaseous system is placed with pressure P_1, volume V_1 and temperature T_1, it has undergone thermodynamic changes where temperature is remaining constant, it is

A. Adiabatic process

B. Isothermal process

C. Isobaric process

D. Isochoric process

Answer: B

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3. The respective examples of extensive and intensive properties are

A. Enthalpy, Entropy

B. Entropy, Enthalpy

C. Entropy, Temperature

D. Temperature, Entropy

Answer: C

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4. A thermally isolated gaseous system can exchange energy with the surroundings. The mode of energy may be

A. Heat

B. Work

C. Heat and radiation

D. Internal energy

Answer: B

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5. Which of the following is a state function?

A. q

B. Work

C. q + w

D. All of these

Answer: C

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6. For the reaction $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

A. $\Delta H = \Delta E$

B. $\Delta H > \Delta E$

C. $\Delta H < \Delta E$

D. Can't predicted

Answer: B

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7. If 'r' is the work done on the system and 's' is heat evolved by the system then,

A. $\Delta E = r + s$

B. $\Delta E = r - s$

C. $\Delta E = r$

D. $\Delta E = s$

Answer: A

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8. For the reaction

$aA(s)+bB(g)\to dD(s)+cC(g)$. Then

A. $\Delta H-\Delta E=(b-d)RT$

B. $\Delta H-\Delta E=(c-b)RT$

C. $\Delta H-\Delta E=(a+b)-(c+d)RT$

D. $\Delta H-\Delta E=(a-d)RT$

Answer: B

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9. A system absorbs 10 kJ of heat and does 4 kJ of work. The internal energy of the system

A. Decrease by 6 kJ

B. Increase by 6 kJ

C. Decrease by 14 kJ

D. Increase by 14 kJ

Answer: B

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10. In a reaction, all reactant and products are liquid, then

A. $\Delta H > \Delta E$

B. $\Delta H < \Delta E$

C. $\Delta H = \Delta E$

D. Can't predicted

Answer: C

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11. Regarding the internal energy of the molecule, which of the following statement is correct?

A. Its absolute value can be successfully calculated.

B. Its absolute value cannot be determined.

C. It is the sum of vibrational and rotational energies.

D. Both (1) & (3)

Answer: B

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12. The heat of transition (ΔH_t) of graphite into diamond would be, where

C (graphite) $+ O_2(g) \rightarrow CO_2(g), \Delta H =$ x kJ

C (diamond) $+ O_2(g) \rightarrow CO_2(g), \Delta H =$ y kJ

A. $x_1 + x_2$

B. $x_2 - x_1$

C. $x_1 - x_2$

D. $x_1 x_2$

Answer: B

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13. For the given reactions, $A \rightarrow D, \Delta H = x$. Steps involved are

$A \rightarrow B, \Delta H_1 = x_1$

$B \rightarrow C, \Delta H_2 = ?$

$C \rightarrow D, \Delta H_3 = x_3$

A. $\Delta H_2 = x - (x_1 + x_3)$

B. $\Delta H_2 = x + x_1 + x_3$

C. $\Delta H_2 = x_1 - x_3 - x$

D. $\Delta H_2 = (x_1 + x) - x_3$

Answer: A

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14. The heats of combustion of yellow P and red P are $-9.91 kJ$ and $-8.78 kJ$ respectively. The heat of transition of yellow to red phosphorus is

A. $-18.69 kJ$

B. $+1.13 kJ$

C. $+18.69 kJ$

D. $-1.13 kJ$

Answer: D

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15. If the heat of formation of NO_2 is 'x' $\left[\frac{1}{2}N_2(g)+O_2(g)\rightarrow NO_2(g)\right]$ the heat of reaction $N_2(g)+O_2(g)\rightarrow 2NO(g)$ is y and the heat of reaction $2NO_g+O_2(g)\rightarrow 2NO_2(g)$ is z, then

A. (a) $2x+z=y$

B. (b) $2y+z=x$

C. (c) $2x-z=y$

D. (d) $2z+x=y$

Answer: C

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16. In the reactions

$HCl+NaOH\rightarrow NaCl+H_2O+xcal.$

$H_2SO_4+2NaOH\rightarrow Na_2SO_4+2H_2O+ycal.$

A. $x=y$

B. $x = 2y$

C. $x = \frac{y}{2}$

D. $x = \sqrt{y}$

Answer: C

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17. $\Delta H_1 C_2 H_4 = 12.5 kcal$

Heat of atomisation of C = 171 Kcal

Bond energy of H_2 = $104.3 kcal$

Bond energy C - H = 99.3 kcal

What is C = C bond energy?

A. $140.9 kcal$

B. $49 kcal$

C. $40 kcal$

D. $76 kcal$

Answer: A

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18. Difference between the heats of reaction at constant pressure and a constant volume for the reaction $2C_6H_6(l) + 15O_2(g) \to 12CO_2(g) + 6H_2O(l)$ at $25^\circ C$ in kJ is

A. $-7.43kJ$

B. $+3.72kJ$

C. $-3.72kJ$

D. $+7.43kJ$

Answer: A

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19. $S_{(\text{rhombic})} + O_{2(g)} \rightarrow SO_{2(g)}, \Delta H = -297.5KJ$

$S_{(\text{monoclinic})} + O_{2(g)} \rightarrow SO_2, \Delta H = -300KJ$

The data can predict that -

A. Rhombic sulphur is yellow in colour

B. Monoclinic sulphur has metallic lustre

C. Monoclinic sulphur is more stable

D. $\Delta H_{Transition} of S(R) \rightarrow S(M)$ is endothermic process

Answer: D

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20. If $S + O_2 \rightarrow SO_2, \Delta H = -298.2 \text{ kJ mole}^{-1}$

$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 \Delta H = -98.7 \text{ kJ mole}^{-1}$

$SO_3 + H_2O \rightarrow H_2SO_4, \Delta H = -130.2 \text{ kJ mole}^{-1}$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2SO_4, \Delta H = -287.3 \text{ kJ mole}^{-1}$

the enthlapy of formation of H_2SO_4 at 298 K will be

A. $-814.4kJ$

B. $-650.3kJ$

C. $-320.5kJ$

D. $-433.5kJ$

Answer: A

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21. The volume of a gas expands by $0.25m^3$ at a constant pressure of 10^3Nm^2. The work done is equal to

A. $2.5erg$

B. $250J$

C. $250wa$

D. $250 \neq w \rightarrow n$

Answer: B

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22. When 1 g of anhydrous oxalic acid is burnt at $25^{\circ} C$, the amount of heat liberated is $2.835 kJ . \Delta H$ combustion is (oxalic acid : $C_2H_2O_4$)

A. $-255.15 kJ$

B. $-445.65 kJ$

C. $-295.24 kJ$

D. $-155.16 kJ$

Answer: A

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23. The heat of neutralization of LiOH and HCl at $25^{\circ} C$ is $-34.868 kJ mol^{-1}$. The heat of ionisation of LiOH will be

A. $44.674 kJ$

B. $22.232kJ$

C. $32.684kJ$

D. $96.464kJ$

Answer: B

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

A. $HCI(\Delta H = -17.74)$

B. $HNO_3(\Delta H = -7.85)$

C. $NH_4NO_3(\Delta H = +16.8)$

D. $NaCI(\Delta H = +1.02)$

Answer: C

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25. $HA + OH \rightarrow H_2O + A^{-+}q_1kJH^+ + OH^- \rightarrow H_2O + q_2kJ$ the enthalpy of ionisation of HA is

A. $(q_1 + q_2)$

B. $(q_1 - q_2)$

C. $(q_2 - q_1)$

D. $-(q_1 + q_2)$

Answer: C

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26. An athlete takes 100 g of glucose of energy equivalent to 1560 kJ. How much amount of energy is uptaken by 1 g molecule of glucose?

A. $15.6kJ$

B. $2808kJ$

C. $1560kJ$

D. $28.08kJ$

Answer: B

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27. For the reaction

$C_6H_{12}(l) + 9O_2(g) \rightarrow 6H_2O(l) + 6CO_2(g)$, $\Delta H = -936.9kcal$

Which of the following is true ?

A. $-936.9 = \Delta E - \left(2 \times 10^{-3} \times 298 \times 3\right)kcal$

B. $+936.9 = \Delta E + \left(2 \times 10^{-3} \times 298 \times 3\right)kcal$

C. $-936.9 = \Delta E - \left(2 \times 10^{-3} \times 298 \times 2\right)kcal$

D. $-936.9 = \Delta E + \left(2 \times 10^{-3} \times 298 \times 2\right)kcal$

Answer: A

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28. For strong acid strong base neutralisation energy for 1 mole H_2O formation is $-57.1kJ$.If 0.25 mole of strong monoprotic acid is reacted with 0.5 mole of strong base then enthalpy of neutralisation is

A. $-(0.25 \times 57.1)$

B. 0.5×57.1

C. 57.1

D. $-(0.5 \times 57.1)$

Answer: A

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29. The heat of combustion of solid benzoic acid at constant volume is `-321.3 kJ at 27 degree Celcius . The heat of combustion at constant pressure is

A. $-321.3 - 300R$

B. $-321.30 + 300R$

C. $-321.3 - 150R$

D. $-321.3 + 900R$

Answer: C

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30.

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), BE(H-H) = x_1, BE(O=O) = x_2, BE($

Latent heat of vaporization of liquid water into water vapour $= x_4$ then

ΔH_f (heat of formation of liquid water) is:

A. $x_1 + \frac{x_2}{2} - x_3 + x_4$

B. $2x_3 - x_1 - \frac{x_2}{2} - x_4$

C. $x_1 + \frac{x_2}{2} - 2x_3 - x_4$

D. $x_1 + \frac{x_2}{2} - 2x_3 + x_4$

Answer: D

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31. A cylinder contains either ethylene or propylene 12 ml of gas required 54 ml of oxygen for complete combustion. The gas is

A. Ethylene

B. Propylene

C. $1:1$ mixture of two gases

D. $1:2$mixture

Answer: B

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32. The specific heat at constant volume for a gas is 0.075 cal/g and at constant pressure is 0.125 cal/g. Calculate

(i) Molecular weight of gas

(ii) Atomicity of gas

(iii) Number of atoms of gas in its 1 mole

A. One

B. Two

C. Three

D. Four

Answer: A

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33. $H(g) + O(g) \rightarrow O - H(g), \Delta H$ for this reaction is

A. Heat of formation of O - H

B. Bond energy of O - H

C. Heat of combustion of H_2

D. Zero at all temperatures

Answer: B

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34. Energy required to dissociate 4 g of gaseous hydrogen into free gaseous atoms is 208 k cal at $25^\circ C$. The bond energy of H-H bond will be

A. $8.72kJ$

B. $4.36kJ$

C. $436kJ$

D. $43.6kJ$

Answer: C

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35. The dissociation energy of $CH_4(g)$ is 360 kcal mol^{-1} and that of $C_2H_6(g) is 620 kcal mol^{-1}$. The C-C bond energy

A. $260 kcal mol^{-1}$

B. $180 kcal mol^{-1}$

C. $130 kcal mol^{-1}$

D. $80 kcal mol^{-1}$

Answer: D

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36. The enthalpy of reaction, $2HC = CH + 5O_2 \rightarrow 4CO_2 + 2H_2O$

If the bond energies of $C - H, C = C, O = O, C = O$ and $O - H$ bonds are p,q,r,s,t repectively

A. $[8s + 4t] - [4p + 2q + 5r]$

B. $[4p + 2q + 5r] - [8s + 4t]$

C. $[4p + 2q + 5r + 8s + 4t]$

D. $[2p + q + 5r] - [8s + 4t]$

Answer: B

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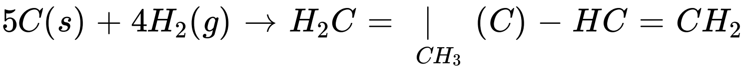
37. Calculate heat of formation of isoprene using bond energy data.



$$5C(s) + 4H_2(g) \rightarrow H_2C = \underset{CH_3}{|} (C) - HC = CH_2$$

Given $C - H = 98.8kcal$

$H - H = 104kcal$

C – C= 83 kcal

C = C = 147 kcal and $C(s) \rightarrow C(g) = 171kcal$

A. $-21kcal$

B. $21kcal$

C. $40kcal$

D. $50kcal$

Answer: B

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38. In a flask colourless N_2O_4 is in equilibrium with brown coloured NO_2. At equilibrium, when the flask is heated at $100^\circ C$ the brown colour deepens and on cooling it becomes less coloured. The change in enthalpy, ΔH for this system is

A. Negative

B. Positive

C. Zero

D. Undefined

Answer: B

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39. For which of these reactions will there be ΔS positive?

A. $H_2O(g) \rightarrow H_2O(l)$

B. $H_2(g) + I_2(g) \rightarrow 2HI(g)$

C. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

D. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Answer: C

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40. For stretched rubber, Entropy

A. Increases

B. First increases then decreases

C. Decreases

D. First decreases then increases

Answer: C

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41. The most random state of H_2O system is

A. ice

B. Liquid water

C. Steam

D. Randomness is same in all

Answer: A

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42. ΔS for the reaction ,

$MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$ will be :

A. Zero

B. $-ve$

C. $+ve$

D. ∞

Answer: C

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43. The standard entroples of $N_2(g), H_2(g)$ and $NH_3(g)$ are $191.5, 130.5, 192.6 Jk^{-1} mol^{-1}$. The value of ΔS° of formation of ammonia is

A. $-98.9 JK^{-1} mol^{-1}$

B. $Zero$

C. $+129.4 JK^{-1} mol^{-1}$

D. $-29.4 JK^{-1} mol^{-1}$

Answer: A

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44. What is the increase in entropy when $11.2 L of O_2$ are mixed with $11.2 L of H_2$ at STP?

A. (a) $0.576\frac{J}{K}$

B. (b) $5.76\frac{J}{K}$

C. (c) $7.56\frac{J}{K}$

D. (d) $2.76\frac{J}{K}$

Answer: B

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45. Given $S^{\circ}_{C_2H_6} = 225 Jmol^{-1}K^{-1}$,

$S_{C_2H_4^{\circ}} = 220 Jmol^{-1}K^{-1}, S_{H_2^{\circ}} = 130 Jmol^{-1}K^{-1}$

Then ΔS° for the process

$C_2H_4 + H_2 \rightarrow C_2H_6$ is

A. $+25J$

B. $-125J$

C. $135J$

D. $315J$

Answer: B

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46. For the meltig of NaCl heat require is $7.26kcalmol^{-1}$ and ΔS increases by $6.73calmol^{-1}k^{-1}$. The melting point of the salt is

A. (a) $805.75^\circ C$

B. (b) $500K$

C. (c) $1.77K$

D. (d) $1.77^{\circ} C$

Answer: A

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47. The ΔS for the reaction

$2H_2(g) + O_2(g) \rightarrow 2H_2O(I) at 500K$ when

$S^{\circ}_{H_2}(g) = 126.6, S_{O^{\circ}_2(g)=201.20},$

$S_{H_2O(I)=68.0JK^{-1}mol^{-1}}$ respectively is

A. $-318.4JK^{-1}mol^{-1}$

B. $318.4JK^{-1}mol^{-1}$

C. $31.84JK^{-1}mol^{-1}$

D. $3.184JK^{-1}mol^{-1}$

Answer: A

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48. Which of the following is correct ?

A. $\begin{array}{ccc} \Delta H & \Delta S & \text{Nature of reaction} \\ (+) & (-) & \text{Nonspontaneous regardless of temperature} \end{array}$

B. $\begin{array}{ccc} \Delta H & \Delta S & \text{Nature of reaction} \\ (-) & (+) & \text{Spontaneous only at high temperature} \end{array}$

C. $\begin{array}{ccc} \Delta H & \Delta S & \text{Nature of reaction} \\ (+) & (+) & \text{Spontaneous only at low temperature} \end{array}$

D. $\begin{array}{ccc} \Delta H & \Delta S & \text{Nature of reaction} \\ (+) & (-) & \text{Spontaneous at all temperatures} \end{array}$

Answer: B

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49. Entropy of vaporisation of water at $100^{\circ} C$, if molar heat of vaporisation is $8710 cal mol^{-1}$ will be

A. $20 cal mol^{-1} K^{-1}$

B. $23.36 cal mol^{-1} K^{-1}$

C. $24 cal mol^{-1} K^{-1}$

D. $28.0 cal mol^{-1} K^{-1}$

Answer: B

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50. A particular reaction at $27^{\circ}C$ for which $\Delta H > 0$ and $\Delta S > 0$ is found to be non-spontaneous. The reaction may proceed spontaneously if

A. The temperature is decreased

B. The temperature is increased

C. The temperature is kept constant

D. It is carried in open vessel at $27^{\circ}C$

Answer: B

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51. It is impossible for a reaction to take place if

(a)Δ H i s + v e and Δ S i s + v e

(b) Δ H i s – v e and Δ S i s + v e

(c) Δ H i s + v e and Δ S i s – v e

(d) Δ H i s – v e and Δ S i s – v e

A. $\Delta His + ve$ and$\Delta Sis + ve$

B. $\Delta His - ve$ and$\Delta Sis + ve$

C. $\Delta His + ve$ and$\Delta Sis - ve$

D. $\Delta His - ve$ and$\Delta Sis - ve$

Answer: C

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52. Ths standard free energy change ΔG° is related to K (equilibrium constant) as`

A. $\Delta G^\circ = -2.303RT\log K$

B. $\Delta G^\circ = 2.303RT\log K$

C. $\Delta G^\circ = RT\log K$

D. $\Delta G^\circ = -RT\log K$

Answer: A

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53. The sole criterion for the spontaneity of a process is

A. Tendencyy to acquire minimum energy

B. Tendency to acquire maximum randomness

C. Tendency to acquire minimum energy and maximum randomness

D. Tendency to acquire maximum stability

Answer: D

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54. For an endothermic reaction to be spontaneous

A. $\Delta G = 0$

B. $\Delta G > 0$

C. $\Delta G < 0$

D. $\Delta G maybe + ve \text{ or } - ve$

Answer: C

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55. At $27^\circ C$ for reaction,

$$C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$$

proceeds spontaneously because the magnitude of

A. $\Delta H = T\Delta S$

B. $\Delta H > T\Delta S$

C. $\Delta H < T\Delta S$

D. $\Delta H > 0 \text{ and } T\delta S < 0$

Answer: B

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ASSIGNMENT (Section - B) Objective Type Questions

1. Let (C_v) and (C_p) denote the molar heat capacities of an ideal gas at constant volume and constant pressure respectively . Which of the following is a universal constant?

A. $C_p - C_v = R$

B. $C_p - C_v = \frac{R}{2}$

C. $C_p - C_v = -2R$

D. $C_p - C_v = 0$

Answer: A

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2. 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

Answer: A

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3. ΔS° will be highest for the reaction

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

B. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

C. $C(s) + O_2(g) \rightarrow CO_2(g)$

D. $N_2(g) + O_2(g) \rightarrow 2NO(g)$

Answer: B

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4. In a reversible process, the value of $\Delta S_{sys} + \Delta S_{surr} is$

A. $+ve$

B. $-ve$

C. Zero

D. All of these

Answer: A

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

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

Answer: D

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6. A process is called reversible when

A. System and surrounding change into each other

B. There is no boundary between system and surrounding

C. The surroundings are always in equilibrium with the system

D. The system changes into the surroundings spontaneously

Answer: C

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7. The molar heat capacity C of water at constant pressure is $75 JK^{-1}\text{mol}^{-1}$, 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. $1.2K$

B. $2.4K$

C. $4.8K$

D. $0.24K$

Answer: D

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8. $16kg$ oxygen gas expands at STP to occupy double of its oxygen volume. The work done during the process is:

A. 260 kcal

B. 180 kcal

C. 130 kcal

D. 271 kcal

Answer: D

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9. When enthalpy and entropy change for a chemical reaction are -2.5×10^3 cals and 7.4 cals K^{-1} respectively. Predict that reaction at 298 K is

A. Spontaneous

B. Reversible

C. Irreversible

D. Non-spontaneous

Answer: A

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

$$Ag_2O_s \rightarrow 2Ag(s) + \frac{1}{2}O_2(g)$$

$\Delta H = 40.5 kJ mol^{-1}$ and $\Delta S = 0.086 kJ mol^{-1} K^{-1}$

A. 470.93 K

B. 362.12 K

C. 262.12 K

D. 562.12 K

Answer: A

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11. One mole of a non-ideal gas undergoes a change of state $(2.0atm, 3.0L, 95K) \to (4.0atm, 5.0L, 245K)$ with a change in internal energy, $\Delta E = 30.0L - atm$. The change in enthalpy (ΔH) of the process in $L - atm$ is

A. 40.0

B. 42.3

C. 44.0

D. 56.0

Answer: C

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

A. ΔE

B. ΔH

C. ΔT

D. All of these

Answer: D

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

A. $\Delta U = W \ne 0, q = 0$

B. $\Delta U = W = q \ne 0$

C. $\Delta U = 0, W = q \ne 0$

D. $W = 0, \Delta U = q \ne 0$

Answer: A

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14. 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. Lowers than that of separate atoms

D. Sometimes lower and sometimes higher

Answer: C

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15. The temperature of 15 ml of a strong acid increases by $2^{\circ} C$ when 15 ml of a strong base is added to it. If 5 ml of each are mixed, temperature should increase by

A. $0.6^\circ C$

B. $0.3^\circ C$

C. $2^\circ C$

D. $6^\circ C$

Answer: C

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16. The standard heat of formation of $NO_2(g)$ and $N_2O_4(g)$ are 8.0 and $4.0 kcal mol^{-1}$ respectively. The heat of dimerisation of NO_2 in kcal is`

A. $-12 kcal$

B. $12 kcal$

C. $4 kcal$

D. $16 kcal$

Answer: A

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17. If $\frac{1}{2}X_2O_{(s)} \to X_{(s)} + \frac{1}{4}O_{2(g)}, \Delta H = 90kJ$ then heat change during reaction of metal X with $1 mole O_2$ to form oxide to maximum extent is :

A. $360kJ$

B. $-360kJ$

C. $-180kJ$

D. $+180kJ$

Answer: B

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18. For a gaseous reaction

$A(g) + 3B(g) \to 3C(g) + 3D(g)$

ΔE is 27 kcal at $37^{\circ} C$. Assuming $R = 2 cal K^{-1} mol^{-1}$ the value of ΔH for the above reaction will be

A. $15.8 kcal$

B. $28.2 kcal$

C. $25.7 kcal$

D. $20.0 kcal$

Answer: B

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19. A mixture of 2 moles of CO and 1 mole of O_2, in a closed vessele is ignited to convert the CO to CO_2 if ΔH is the enthalpy change and ΔU is the change in internal energy then:

A. $\Delta H = \Delta \cup$

B. $\Delta H > \Delta \cup$

C. $\Delta H < \Delta \cup$

D. The relationship depends upon the capacity of vessel

Answer: C

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20. The bond dissociation energies of X_2, Y_2 and XY are in the ratio of $1:0.5:1$. ΔH for the formation of XY is -200 kJ mol^(-1) $. The bond dissociation e \ne rgy of$X_2` will be

A. $800 kJ mol^{-1}$

B. $200 kJ mol^{-1}$

C. $300 kJ mol^{-1}$

D. $400 kJ mol^{-1}$

Answer: A

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

A. 8

B. 16

C. 32

D. 64

Answer: B

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22. If x mole of ideal gas at $27^{\circ}C$ expands isothermally and reversibly from a volume of y to 10 y, then the work done is

A. $w = xR300 \ln y$

B. $w = -300xR\frac{\ln y}{10}y$

C. $w = -300xR \ln 10$

D. $w = 100xR\frac{\ln 1}{y}$

Answer: C

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23. Enthalpy of formation of NH_3 is -X kJ and ΔH_{H-H}, ΔH_{N-H} are respectively Y kJmol^{-1} and Z kjmol^{-1}. The value of $\Delta H_{N=N} is$

A. $Y - 6Z + \frac{X}{3}$

B. $-3Y + 6Z + 2X$

C. $3Y + 6Z + X$

D. $Y + 6X + Z$

Answer: B

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24. A system X undergoes following changes

$$\underset{P_1V_1T_1}{X} \rightarrow \underset{P_2V_2T_1}{W} \rightarrow \underset{P_3V_2T_2}{Z} \rightarrow \underset{P_1V_1T_1}{X}$$

The overall process may be called as

A. Reversible process

B. Cyclic process

C. Cyclic reversible process

D. Isochoric process

Answer: B

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

A. $-2 \times 57.1 kJ$

B. $-57.1 kJ$

C. $-\frac{57.1}{2} kJ$

D. Strong acid and strong base will not undergo neutralisation

Answer: A

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26. The value of ΔH° in kJ for the reaction will be $CS_2(l) + 4NOCl(g) \rightarrow \mathbb{C}Cl_4(l) + 2SO_2(g) + 2N_2(g)$ if

$\Delta H_t^{\circ}(CS_2) = -X$

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

$\Delta H_l^{\circ}(\mathbb{C}CL_4) = +z$

$\Delta H_l^{\circ}(SO_2) = -r$

A. $x + 4y - z - 2r$

B. $r + z + 4y - x$

C. $2r + z + 4y + x$

D. $x + 4y + z - 2r$

Answer: D

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27. The heat librerated on complete combustion of 1 mole of CH_4 gas to $CO_2(g)$ and $H_2O(l)$ is 890 kJ. Calculate the heat evolved by $2.4 L of CH_4$ on complete combustion.

(1 mol of CH4 at 298K and 1 atm= 24L)

A. $95.3 kJ$

B. $8900 kJ$

C. $890 kJ$

D. $89 kJ$

Answer: A

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28. The work done in an open vessel at $300K$, when $112g$ iron reacts with dil. HCL is:

A. $1.1 kcal$

B. $0.6kcal$

C. $0.3kcal$

D. $0.2kcal$

Answer: A

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29. Which statement is correct?

A. $\frac{dh}{(dT)_P} < \frac{dE}{(dT)_V}$

B. $\frac{dH}{(dT)_P} + \frac{dE}{(dT)_V} = R$

C. $\frac{dE}{(dV)_T}$ for ideal gas is zero

D. All of these

Answer: C

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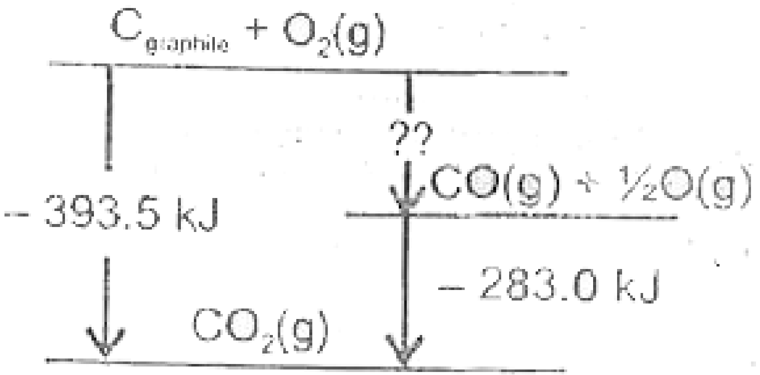
30. A schematic representation of enthalpy changes for the reaction, $C_{\text{graphite}} + \frac{1}{2}O_2(g) \rightarrow CO(g)$ is given below. The missing value is



A. $+10.5kJ$

B. $-11.05kJ$

C. $-110.5kJ$

D. $-10.5J$

Answer: C

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31. Which of the following equations respresents standard heat of formation of CH_4 ?

A. $C_{\text{diamond}} + 2H_2(g) \rightarrow CH_4(g)$

B. $C_{\text{graphite}} + 2H_2(g) \rightarrow CH_4(g)$

C. $C_{\text{diamond}} + 4H(g) \rightarrow CH_4(g)$

D. $C_{\text{graphite}} + 4H(g) \rightarrow CH_4(g)$

Answer: B

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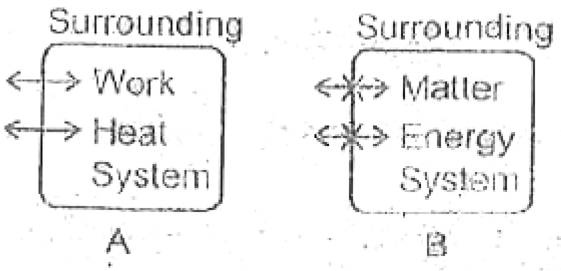
32. Different types of systems are given below



The A and B systems respectively are

A. Open system, Closed system

B. Isolated system, Closed system

C. Adiabatic system, Isolated system

D. Closed system, Isolated system

Answer: D

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33. Set of intensive properties is shown by

A. Mole fraction, standard electrode potential, heat capacity

B. Viscosity, refractive index, specific heat

C. Density, Gibbs free energy, internal energy

D. Number of moles, molarity, electrode potential

Answer: B

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34. For the expansion occuring from initial to final stage in finite time, which is incorrect?

A. Equilibrium exist in initial and final stage

B. Work obtained is maximum

C. Driving force is much greater than the opposing force

D. Both (1) & (2)

Answer: B

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35. Calorific value of ethane, in k J/g if for the reaction $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O, \Delta H = -745.6 kcal$

A. -12.4

B. -52

C. -24.8

D. -104

Answer: B

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ASSIGNMENT (Section - C) Previous Years Questions

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

A. $1136.25J$

B. $-500J$

C. $-505J$

D. $+505J$

Answer: C

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2. For a given reaction, $\Delta H = 35.5 kJ mol^{-1}$ and $\Delta S = 83.6 J K^{-1} mol(-1)$. The reaction is spontaneous at : (Assume that ΔH and ΔS do not vary with temperature)

A. $T < 425K$

B. $T > 425K$

C. All temperature

D. $T > 298K$

Answer: B

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3. For a sample of perfect gas when its pressure is changed isothermally from p_i to p_f, the entropy change is given by

A. $\Delta S = nRIn\left(\frac{p_f}{p_i}\right)$

B. $\Delta S = nRIn\left(\frac{p_i}{p_f}\right)$

C. $\Delta S = nRTIn\left(\frac{p_f}{p_i}\right)$

D. $\Delta S = nRTIn\left(\frac{p_i}{p_f}\right)$

Answer: B

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4. The correct thermodynamic conditions for the spontaneous reaction at all temperature is

A. $\Delta H < 0 \text{ and } \Delta S < 0$

B. $\Delta H < 0 \text{ and } \Delta S = 0$

C. $\Delta H > 0 \text{ and } \Delta S < 0$

D. $\Delta H < 0 \text{ and } \Delta S > 0$

Answer: B::D

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5. Enthalpy of combustion of carbon to CO_2 is $-393.5kJmol^{-1}$ Calculate the heat released upon formation of 35.2 g of CO_2 from carbon and dioxygen gas.

A. $-630kJ$

B. $-3.15kJ$

C. $-315kJ$

D. $+315kJ$

Answer: C

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6. For the reaction:

$X_2O_4(l) \rightarrow 2XO_2(g)$

$\Delta U = 2.1kcal, \Delta S = 20\text{cal}K^{-1}\text{at}300K$

Hence ΔG is

A. $2.7kcal$

B. $-3.9kcal$

C. $9.3kcal$

D. $-9.3kcal$

Answer: B

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7. In which of the following reactions, standard reaction entropy changes (ΔS°) is positive and standard Gibbs energy change (ΔG°) decreases sharply with increasing temperature ?

A. $Mg(s) + \frac{1}{2O_2}(g) \rightarrow MgO(s)$

B. $\frac{1}{2}Cgra\phi te+\frac{1}{2O_2}(g)\rightarrow\frac{1}{2}CO_2(g)$

C. $Cgra\phi te+\frac{1}{2O_2}(g)\rightarrow CO(g)$

D. $CO(g)+\frac{1}{2O_2}(g)\rightarrow CO_2(g)$

Answer: C

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8. Standard enthalpy of vaporisation $\Delta_{\text{vap}}H^{\circ}$ for water at 100°C is $40.66KJ\text{mol}^{-1}$. The internal energy of vaporisation of water at $100^{\circ}C$ (in KJ mol^{-1}) is (assume water vapour to behave like an ideal gas).

A. $+43.76$

B. $+40.66$

C. $+37.56$

D. -43.76

Answer: C

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9. The enthalpy of fusion of water is 1.435 kcal/mol. The molar entropy change for the melting of ice at $0^\circ C$ is

A. $5.260ca\frac{l}{molK}$

B. $0.526ca\frac{l}{molK}$

C. $10.52ca\frac{l}{molK}$

D. $21.04ca\frac{l}{molK}$

Answer: A

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10. Equal volumes of two monoatomic gases, A, B at the 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

Answer: D

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11. 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. $q = 0, \Delta T = 0, w = 0$

Answer: D

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12. If the enthalpy change for the transition of liquid water to steam is $30 kJ mol^{-1}$ at $27^{\circ} C$ 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. $0.1 J mol^{-1} K^{-1}$

Answer: A

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13. Enthalpy change for the reaction,

$4H(g) \rightarrow 2H_2(g)$ is -869.6 kJ

The dissociation energy of H - H bond is

A. $+217.4kJ$

B. $-434.8kJ$

C. $-869.6kJ$

D. $+434.8kJ$

Answer: D

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14. Consider the following processes :

	$\Delta H(kJ/\text{mol})$
$\frac{1}{2}A \rightarrow B$	$+150$
$3B \rightarrow 2C + D$	-125
$E + A \rightarrow 2D$	$+350$

For B + C $\rightarrow$ E + 2C, ΔH will be

A. $-325k\frac{J}{m}ol$

B. $325k\frac{J}{m}ol$

C. $525k\frac{J}{m}ol$

D. $-175k\frac{J}{m}ol$

Answer: D

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15. Standard entropies of X_2, Y_2 and $XY_3 are 60, 40$ and $50 JK^{-1} mol^{-1}$ respectively. For the reaction $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \Leftrightarrow XY_3 \Delta H = -30 KJ$ to be at equilibrium, the temperature should be:

A. 750 K

B. 1000 K

C. 1250 K

D. 500 K

Answer: A

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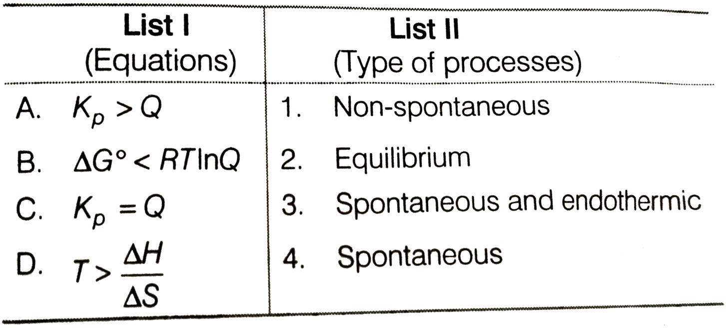
16. Match List I (Equations) with List II (Type of processes) and select the correct option.



List I (Equations)	List II (Type of processes)
A. $K_p > Q$	1. Non-spontaneous
B. $\Delta G° < RT\ln Q$	2. Equilibrium
C. $K_p = Q$	3. Spontaneous and endothermic
D. $T > \frac{\Delta H}{\Delta S}$	4. Spontaneous

(a) a (i) ,b (ii) ,c (iii) ,d (iv)

(b) a (iii) ,b (iv) ,c (ii) ,d (i)

(c) a (iv) ,b (i) ,c (ii) ,d (iii)

(d) a (ii) ,b (i) ,c (iv) ,d (iii)

A. $a(i), b(ii), c(iii), d(iv)$

B. $a(iii), b(iv), c(ii), d(i)$

C. $a(iv), b(i), c(ii), d(iii)$

D. $a(ii), b(i), c(iv), d(iii)$

Answer: C

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17. 1 moles of an ideal gas expanded spontaneously into vaccum. The work done will be

A. Infinite

B. 3 Joules

C. 9 Joules

D. Zero

Answer: D

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18. For vaporization of water at 1 atmospheric pressure the values of ΔH and ΔS are $50.63 kJ mol^{-1}$ and $118.8 JK^{-1} mol^{-1}$ respectively. The temperature when Gibbs energy change (ΔG) for this transformation will be zero, is

A. $273.4K$

B. $393.4K$

C. $426.1K$

D. $293.4K$

Answer: C

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19. The following teo reaction are known :

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$,

$\Delta H = -26.8kJ$

$FeO(s) + CO(g) \rightarrow Fe(s) + CO_2(g)$,

$\Delta H = -16.5kJ$

Correct target equation is

$Fe_2O_3(s) + CO(g) \rightarrow 2FeO(s) + CO_2(g), \Delta H = ?$

A. $+10.3kJ$

B. $-43.3kJ$

C. $-10.3kJ$

D. $+6.2kJ$

Answer: D

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

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

are $170KJ$ and $170JK^{-1}$ respectively. This reaction will be spontaneous at

A. 910 K

B. 1110 K

C. 510 K

D. 710 K

Answer: B

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21. From the following bond energies

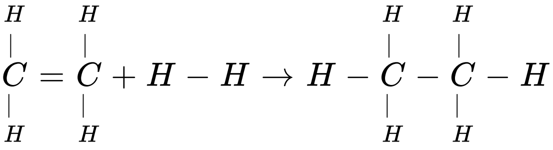
$H - H$ bond energy $431.37 kJ mol^{-1}$

$C = C$ bond energy $606.10 kJ mol^{-1}$

$C - C$ bond energy $336.49 kJ mol^{-1}$

$C - H$ bond energy $410.5 kJ mol^{-1}$

Enthalpy for the reaction



$$\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} = \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} + H - H \rightarrow H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - H$$

will be

A. $-243.6 kJ mol^{-1}$

B. $-120.0 kJ mol^{-1}$

C. $553.0 kJ mol^{-1}$

D. $1523.6 kJ mol^{-1}$

Answer: B

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22. 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. $245kJmol^{-1}$

B. $93kJmol^{-1}$

C. $-245kJmol^{-1}$

D. $-93kJmol^{-1}$

Answer: D

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23. For the gas-phase decomposition,

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$

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 $\Delta S < 0$

Answer: C

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24. Which of the following are not state functions ?

I. q+w II. Q

III W. IV . H-TS

A. (II) and(III)

B. (I) and(IV)

C. (II) , (III) and(IV)

D. (I), (II) and(III)

Answer: A

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25. Consider the following reactions:

(i) $H^{+}(aq) + OH^{-}(aq) \rightarrow H_2O(l)$,

$\Delta H = -X_1 KJmol^{-1}$

(ii) $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H = -X_2 KJmol^{-1}$

(iii) $CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(l)$,

$\Delta H = -X_3 KJmol^{-1}$

(iv) $C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$,

$\Delta H = +X_4 KJmol^{-1}$

Enthanlpy of formation of $H_2O(l)$ is

A. $+X_1 kJmol^{-1}$

B. $+X_2 kjmol^{-1}$

C. $+X_{93}) kJmol^{-1}$

D. $+X_4 kJmol^{-1}$

Answer: B

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26. Given that bond energies of H–H and Cl–Cl are 430 kJ mol^{-1} and 240 kJ mol^{-1} respectively and $\Delta_f H$ for HCl is -90 kJ mol^{-1} . Bond enthalpy of HCl is :

A. $245kJmol^{-1}$

B. $2909kJmol^{-1}$

C. $380kJmol^{-1}$

D. $425kJmol^{-1}$

Answer: D

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27. Identify the correct statement for change of Gibbs free energy for a system $(\Delta G_{\text{system}})$ at constant temperature and pressure.

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

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

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

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

Answer: B

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28. Assume each reaction is carried out in an open container. For which reaction will ΔH = ΔE ?

A. $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$

B. $C(s) + 2H_2O(g) \rightarrow 2H_2(g) + CO_2(g)$

C. $PCI_5(g) \rightarrow PCI_3(g) + CI_2(g)$

D. $2CO(g) + O_2(g) \to 2CO_2(g)$

Answer: A

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29. The enthalpy and entropy change for the reaction $Br_2(l) + Cl_2(g) \to 2BrCl(g)$ are $40kJmol^{-1}$ and $110JK^{-1}mol^{-1}$ repectively. The temperature at which the reaction will be in equilibrium is

A. $363.64K$

B. $273K$

C. $450K$

D. $300K$

Answer: A

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

A. $-121 kJ per mol$

B. $+121 kJ per mol$

C. $+242 kJ per mol$

D. $-242 kJ per mol$

Answer: A

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31. A reaction occurs spontaneouly if

A. $T\Delta S < \Delta H$ and both ΔH and $\Delta S are +ve$

B. $T\Delta S > \Delta H$ and both ΔH and $\Delta S are +ve$

C. $T\Delta S = \Delta H$ and both ΔH and $\Delta S are +ve$

D. $T\Delta S > \Delta H \text{ and } \Delta H is + ve \text{ and } \Delta S is - ve$

Answer: B

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

A. Exothermic and decreasing disorder

B. Endothermic and increasing disorder

C. Exothermic and increasing disorder

D. Endothermic and decreasing disorder

Answer: C

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33. The magnitude of enthalpy change for neutralization of the reaction ,

$MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$ (Given $H^+(aq) + OH^-(aq) \rightarrow H_2O(l), \ -57 \ \text{kJ}/\text{mol}$) will be :

A. Less than $-57.33 kJ mol^{-1}$

B. $-57.33 kJ mol^{-1}$

C. Greater than $-57.33 kJ mol^{-1}$

D. $57.33 kJ mol^{-1}$

Answer: A

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

A. $\Delta H = -48 kJ, \Delta S = +135 \frac{J}{K}$

B. $\Delta H = -48 kJ, \Delta S = -135 \frac{J}{K}$

C. $\Delta H = +48kJ, \Delta S = +135\frac{J}{K}$

D. $\Delta H = +48kJ, \Delta S = -135\frac{J}{K}$

Answer: C

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35. On the basis of theromochemical equations (1), (2) and (3), find out which of the algebraic relationships given in options (a) to (d) is correct

(1) C (graphite) $+O_2(g) \rightarrow CO_2(g), \Delta_r H = xkJmol^{-1}$

(2) C (graphite) $+\frac{1}{2}O_2(g) \rightarrow CO(g), \Delta_r H = ykJmol^{-1}$

(3) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta_r H = zkJmol^{-1}$

A. $x = y - z$

B. $z = x + y$

C. $x = y + z$

D. $y = 2z - x$

Answer: C

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36. The combustion reaction occuring in an automobile is $2C_8H_{18}+25O_2(g)\rightarrow16CO_2(g)+18H_2O(g)$ This reaction is accompanied with signs of change in enthalpy, entropy and gibbs free energy

A. $-,\ +,\ +$

B. $+,\ +,\ -$

C. $+,\ -,\ +$

D. $-,\ +,\ -$

Answer: D

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

A. 32

B. 38

C. 317

D. 477

Answer: C

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38. If enthalpies of formation of $C_2H_4(g), CO_2(g)$ and $H_2O(l)$ at $25^{\circ}C$ and 1 atm pressure are 52, -394 and -286 KJ/mol , the enthalpy of combustion of ethane is equal to

A. $+14.2k\frac{J}{m}ol$

B. $+1412k\frac{J}{m}ol$

C. $-141.2k\frac{J}{m}ol$

D. $-1412k\frac{J}{m}ol$

Answer: D

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39. For a reaction to occur spontaneously :

A. ΔH must be negative

B. ΔS must be negative

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

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

Answer: C

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40. Given that ,

$C(s) + O_2(g) \rightarrow CO_2(g), \Delta H^\circ = -xKJ$

$2CO(g) + O_2(g) \rightarrow 2CO_2, \Delta H^\circ = -yKJ$ The enthalpy of formation of carbon monoxide will be

A. $\dfrac{y-2x}{2}$

B. $2x - y$

C. $y - 2x$

D. $\dfrac{2x-y}{2}$

Answer: A

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41. Identify the correct statement regarding entropy

A. At absolute zero of temperature, the entropy of all crystalline substances is taken to be zero

B. At absolute zero of temperature, the entropy of a perfectly crystalline substance is $+ve$

C. At absolute zero of temperature, entropy of a perfectly crystalline substance is taken to be zero

D. At $0^\circ C$, the entropy of a perfectly crystalline substance is taken to be zero.

Answer: C

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42. One mole of an ideal gas at 250 K is expanded isothermally from an initial volume of 5 litre to 10 litres. The ΔE for this process is $(R = 2cal.\, Mol^{-1}K^{-1})$

A. $1381.1cal$

B. Zero

C. $163.7cal$

D. $9Latm$

Answer: B

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

A. $(2x+y)$

B. $(x-y)$

C. $(x+y)$

D. $(y-2x)$

Answer: D

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44. At $27^{\circ} C$ latent heat of fusion of a compound is 3930 J/mol. Entropy change is

A. $13.10 \frac{J}{m} olK$

B. $10.77 \frac{J}{m} olK$

C. $9.07 \frac{J}{m} olK$

D. $0.977 \frac{J}{m} olK$

Answer: A

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45. For the reaction $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$, which one is true ?

A. $\Delta H = \Delta E - RT$

B. $\Delta H = \Delta E + RT$

C. $\Delta H = \Delta E + 2RT$

D. $\Delta H = \Delta E - 2RT$

Answer: A

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46. Change in enthalpy for reaction, $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$ if heat of formation of $H_2O_2(l)$ and $H_2O(I)$ are -188 and -286 KJ/mol respectively is

A. $-196k\frac{J}{m}ol$

B. $+196k\frac{J}{m}ol$

C. $+948k\frac{J}{m}ol$

D. $-948k\frac{J}{m}ol$

Answer: A

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47. When 1 mole gas is heated at constant volume, temperature is raised from 298 to 308 K. Heat supplied to the gas in 500 J. Then, which statement is correct ?

A. $q = \Delta \cup = -500J, w = 0$

B. $q = \Delta \cup = +500J, w = 0$

C. $q = w - 500J, \Delta \cup = 0$

D. $\Delta \cup = 0, q = w = -500J$

Answer: B

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48. Enthalpy of the reaction

$CH_4 + \frac{1}{2}O_2 \rightarrow CH_3OH$, 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. $x \geq y$

Answer: A

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49. The unit of entropy is

A. $JK^{-1}mol^{-1}$

B. $Jmol^{-1}$

C. $J^{-1}K^{-1}mol^{-1}$

D. $JKmol^{-1}$

Answer: A

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50. In a closed insulated 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. $W = 0, \Delta E = q \neq 0$

Answer: A

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51. 2 moles of an ideal gas at $27^\circ C$ temperature is expanded reversibly from 2 L to 20 L . Find entropy change (R=2 cal/mol K).

A. 92.1

B. 0

C. 4

D. 9.2

Answer: D

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52. Heat of combustion ΔH° for $C(s), H_2(g)$ and $CH_4(g)$ are $-94, -68$ and $-213 Kcal/mol$. Then ΔH° for $C(s) + 2H_2(g) \rightarrow CH_4(g)$ is

A. $-17 kcal$

B. $-111 kcal$

C. $-170 kcal$

D. $-85 kcal$

Answer: A

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53. For the reaction

$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$ at constant temperature , $\Delta H - \Delta E$ is`

A. $+RT$

B. $-4RT$

C. $-3RT$

D. $-RT$

Answer: B

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54. What is the entropy change ($\in JK^{-1}mol^{-1}$) when one mole of ice is converted into water at $0^{\circ}C$? (The enthalpy change for the conversion of ice to liquid water is $6.0kJmol^{-1}at0^{\circ}C$)

A. 20.13

B. 2.013

C. 2.198

D. 21.98

Answer: D

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55. For which one of the following equations ΔH_r° equal to ΔH_f° for the product ?

A. $N_2(g) + O_3(g) \rightarrow N_2O_3(g)$

B. $CH_4(g) + 2CI_2(g) \rightarrow CH_2CI_2(I) + 2HCI(g)$

C. $Xe(g) + 2F_2(g) \rightarrow XeF_4(g)$

D. $2CO(g) + O_2g) \rightarrow 2CO_2(g)$

Answer: C

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56. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are $-582.64kJmol^{-1}$ and $-150.6Jmol^{-1}k^{-1}$, respectively. Standard Gibb's energy change for the same reaction at 298 K is

A. $-221.1kJmol^{-1}$

B. $-537.7kJmol^{-1}$

C. $-439.3kJmol^{-1}$

D. $-523.2kJmol^{-1}$

Answer: B

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

A. $\Delta S_{\text{system}} + \Delta S_{\text{surroundings}} > 0$

B. $\Delta S_{\text{system}} - \Delta S_{\text{surroundings}} > 0$

C. $\Delta S_{\text{system}} > 0 only$

D. $\Delta S_{\text{surroundings}} > 0$ only

Answer: A

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58. The work done during the expansion of a gas from a volume of $4dm^3$ to $6dm^3$ against a constant external pressure of 3 atm, is

A. $-6J$

B. $-608J$

C. $+304J$

D. $-304J$

Answer: B

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59. The enthalpy of hydrogenation of cyclohexene is $-119.5kJmol^{-1}$. If resonance energy of benzene is $-150.4kJmol^{-1}$, its enthalpy of hydrogenation would be :

A. $-358.5kJmol^{-1}$

B. $-508.9kJmol^{-1}$

C. $-208.1kJmol^{-1}$

D. $-269.9kJmol^{-1}$

Answer: C

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60. $2Zn+O_2 \rightarrow 2ZnO\ \Delta G^\circ = -616J$

$2Zn+S_2 \rightarrow 2ZnS\ \Delta G^\circ = -293J$

$S_2+2O_2 \rightarrow 2SO_2\ \Delta G^\circ = 0408J$

ΔG° for the following reaction is:

$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

A. $-1462J$

B. $-1317J$

C. $-501J$

D. $-731J$

Answer: D

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ASSIGNMENT (Section -D) Assertion-Reason Type Questions

1. A : $C_{\text{diamond}} \rightarrow C_{\text{graphite}}$

ΔH and ΔU are same for this reaction.

R: Entropy increases during the conversion of diamond to graphite.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: B

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2. A: Specific heat is an intensive property

R: Heat capacity is an extensive property.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason is false, then mark (4)

Answer: B

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3. A: All reactions which are exothermic are spontaneous

R: All reactions in which entropy increases are spontaneous

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason is false, then mark (3)

Answer: D

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4. A: Enthalpy of neutralisation of 1 equivalent each of HCl and H_2SO_4 with NaOH is same.

R : Enthalpy of neutralisation is always the heat evolved when 1 mole acid is neutralised by a base.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason is false, then mark (3)

Answer: C

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5. ΔU is state function but heat and work are not state funcitons.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: B

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6. A : Dissolution of sugar in water proceed via increases in entropy

R: Entropy decreases when egg is hard boiled.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: C

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7. A : For an isolated system $\Delta G = -T\Delta S_{\text{total}}$

R: For an isolated system q = 0.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion Reason is false, then mark

Answer: B

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8. A: Combustion is an exothermic process.

R: Combustion is a spontaneous process.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: B

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9. A: Total enthalpy change of a multistep process is sum of $\Delta H_1 + \Delta H_2 + \Delta H_3 + ...$

R: When heat is absorbed by the system, the sign of q is taken to be negative.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: C

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10. A : Bond energy is equal to enthalpy of formation with negative sign.

R: Bond energy is energy required to dissociate 1 mole single bond.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: C

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11. A: ΔH is positive for endothermic reactions.

R : If total enthalpies of reactants and products are $H_R \& H_P$ respectively then for an endothermic reaction $H_R < H_P$

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: A

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12. A : The energy of the universe is constant, whereas the entropy of the universe is continuously increasing.

R : For spontaneous process $\Delta S > 0$.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: B

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13. A: A non- spontaneous process becomes spontaneous when coupled with a suitable spontaneous reaction.

R: The overall free energy of coupled spontaneous reaction is negative.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: A

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14. A: An ideal crystal has more entropy than a real crystal.

R: An ideal crystals has more disorder.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason is false, then mark (4)

Answer: D

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15. A: Work done in an irreversible isothermal process at constant volume is zero.

R: Work is assigned negative sign during expansion and is assigned positive sign during compression.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion , then mark (1)

B. If both Assertion & Reason are true and the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3)

D. If both Assertion is true statement but Reason is false, then mark (3)

Answer: B

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