CHEMISTRY

BOOKS - TARGET CHEMISTRY (HINGLISH)

CHEMICAL THERMODYNAMICS AND ENERGETICS

Classical Thinking

1. Thermodynamics is concerned with

    A. total energy of a system

    B. energy changes in a system

    C. rate of chemical change

    D. mass changes in nuclear reactions

Answer: B

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C. system - surroundings

D. system + surroundings

Answer: D

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4. The remaining portion of the universe EXCEPT the system is called _____.

A. boundary

B. isolated system

C. closed system

D. surrounding

Answer: D

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5. A system, which can exchange mass as well as energy with its surroundings is called as _____.

    A. isolated system

    B. open system

    C. closed system

    D. inert system

Answer: B

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6. Which of the following is an extensive property of the system?

    A. refractive index

    B. viscosity

    C. internal energy

    D. temperature

Answer: C

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7. The intensive property among these quantities is

    A. heat capacity

    B. mass/volume

    C. mass

    D. volume

Answer: B

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8. In an isothermal expansion of an ideal gas, _____.

    A. $\Delta P = 0$

B. $\Delta V = 0$

C. $\Delta U = 0$

D. $\Delta W = 0$

Answer: C

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9. In case of an ideal gas undergoing transformation where Delta T = 0 for the process, its internal energy _____.

A. increases as the pressure increases

B. decreases as the volume decreases

C. decreases as the pressure decreases

D. remains fixed

Answer: D

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10. For an isobaric process, which of the following is TRUE?

A. $\Delta P = 0$

B. $\Delta U = q_p$

C. $q = \ +W$

D. $P\Delta V = 0$

Answer: A

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11. For an isochoric process, the changes(s) in _____.

A. pressure is zero

B. temperature is zero

C. volume is zero

D. both pressure and temperature are zero

Answer: C

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12. An adiabatic process is one in which _____.

    A. all energy is transferred as heat

    B. volume of the system remains constant

    C. there is no exchange of heat between the system and its

       surroundings

    D. pressure of the system remains constant

Answer: C

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13. A process in which system comes to its initial state through a number of different processes is called _____.

A. irreversible process

B. reversible process

C. adiabatic process

D. cylic process

Answer: D

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14. In a cylic process, _____.

A. $\Delta U = 0, \Delta V = 0, W = 0$

B. $\Delta U = 0, \Delta V = 0, W \neq 0$

C. $\Delta V = 0, W = 0$

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

Answer: B

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15. One calorie is equal to _____.

A. 0.4184 Joule

B. 4.184 Joule

C. 41.84 Joule

D. 418.4 Joule

Answer: B

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16. If one mole of a gas occupying y L volume is expanded against a constant external pressure of one atmosphere to a volume of x L, the work done by the system is _____.

A. $-p_{ex}(x + y)$

B. $-p_{ex}(x - y)$

C. $-p_{ex}(x/y)$

D. $-p_{ex}/(x-y)$

Answer: B

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17. Which one of the following process is reversible?

A. Melting of ice at $10°C$.

B. Mixing of three gases by diffusion.

C. Evaporation of water 373 K and 1 atm pressure in closed container.

D. A solid NaCl dissolves in water.

Answer: C

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18. When heat is released during the reaction, it is denoted as _____ and when work is done on system by the surroundings, it is denoted as _____ .

A. positive, positive

B. negative, negative

C. positive, negative

D. negative, positive

Answer: D

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19. Which of the following statement is CORRECT?

A. The work done on the system by the surroundings is negative.

B. The work done by the system on the surroundings is positive.

C. The heat absorbed by the system from the surroundings is positive.

D. The heat absorbed by the surroundings from the system is positive.

Answer: C

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20. A system absorbs 920 J of heat and does work. The change in internal energy (ΔU) for the process is 460 J. The work done by the system is

_____ .

A. 250 J

B. $-250 J$

C. 460 J

D. $-460 J$

Answer: D

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21. In a process, a system does 238 J of work on its surrounding by absorbing 54 J heat. What is the change in internal energy of system during the operation?

A. 54 J

B. 222 J

C. $-184J$

D. $-192J$

Answer: C

22. ΔU for a system that does 1000 cal of work on the surroundings when 200 cal of heat are absorbed by the system is _____ .

A. -800 cal

B. $+800$ cal

C. -1200 cal

D. $+1200$ cal

Answer: A

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23. 1st law of thermodynamics introduces the concept of _____ .

A. temperature

B. pressure

C. change in direction of reaction

D. conservation of energy

Answer: D

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24. The law of conservation of energy states that, _____ .

A. the internal energy of a system is constant

B. the heat content of a system is constant

C. energy is neither created nor destroyed

D. there is an equivalence between energy and mass

Answer: C

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25. The second law of thermodynamics states that

A. all machines have an efficiency unity

B. energy can neither be created nor destroyed

C. all spontaneous processes are thermodynamically irreversible

D. heat can be completely converted into work without leaving changes in the system

Answer: C

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26. The sum of the internal energy of the system and the energy that arises due to its pressure and volume is called _____ of the system.

A. internal energy

B. enthalpy

C. entropy

D. free energy

Answer: B

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27. In a reaction, all products and reactants are liquids, hence _____ .

A. $\Delta H > \Delta U$

B. $\Delta H < \Delta U$

C. $\Delta H = \Delta U$

D. $\Delta H = \Delta U = 0$

Answer: C

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28. Enthalpy change does NOT equals internal energy change when _____ .

A. all the reactants and products are in solution

B. reaction is carried out in a clossed vessel

C. number of moles of gaseous reactants and that of products are

   equal

D. reaction is carried out at constant pressure

Answer: D

29. What is Δn for combustion of 1 mole of benzene, when both the reactants and the products are gas at 298 K?

A. 0

B. $\dfrac{3}{2}$

C. $\dfrac{-3}{2}$

D. $\dfrac{1}{2}$

Answer: D

30. ΔH and ΔU for the reaction,

$2S_{(s)} + 3O_{2(g)} \rightarrow 2SO_{3(g)}$, are related as _____ .

A. $\Delta H = \Delta U - 1.5RT$

B. $\Delta H = \Delta U - 0.5RT$

C. $\Delta H = \Delta U - RT$

D. $\Delta H = \Delta U + 1.5RT$

Answer: C

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31. The enthalpy change for the reaction,

$H_2O_{(s)} \rightarrow H_2O_{(l)}$, $\Delta H = +6.01kJmol^{-1}at0°C$ is called enthalpy

of _____ .

A. vaporization

B. fusion

C. combustion

D. solution

Answer: B

32. Born-Haber cycle is used to determine

A. electron gain enthalpy

B. electron affinity

C. enthalpy of ionization

D. crystal lattice enthalpy

Answer: D

33. Thermodynamics is concerned with

    A. change in temperature

    B. change in heat energy

    C. change in volume

    D. change in internal energy

Answer: B

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34. The heat or reaction does not depend upon :

    A. temperature of the reaction

    B. physical state of reactants and products

    C. whether the reaction is carried out at constant pressure or at

        constant volume

D. the method by which the final products are obtained from the reactants

Answer: D

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35. The heat of a chemical reaction is given by the following expression, _____ .

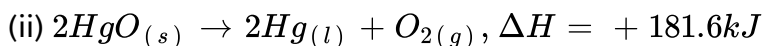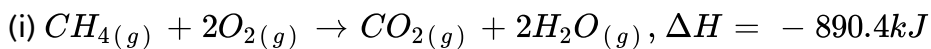A. $\Delta H = \Sigma H_R - \Sigma H_P$

B. $\Delta H = \Sigma H_R$

C. $\Delta H = \Sigma H_P - \Sigma H_R$

D. $\Delta H = \Sigma H_P$

Answer: C

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36. Study the following two reactions:

(i) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}, \Delta H = -890.4kJ$

(ii) $2HgO_{(s)} \rightarrow 2Hg_{(l)} + O_{2(g)}, \Delta H = +181.6kJ$

Which of the following statements is CORRECT?

A. both reactions are exothermic.

B. both reactions are endothermic.

C. reaction (i) is endothermic and (ii) is exothermic

D. reaction (i) is exothermic and (ii) is endothermic

Answer: D

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37. Evaporation of water is

A. an endothermic change

B. an exothermic change

C. a process where no heat change occurs

D. a process accompanied by chemical reaction

Answer: A

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38. An exothermic reaction is one in which the reacting substances :

A. have more energy than the products

B. have less energy than the products

C. are at a higher temperature than the product

D. are at a lower temperature than the product

Answer: A

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39. Conversion of oxygen to ozone represented by the equation $3O_2 \rightarrow 2O_3$ is an endothermic reaction. Enthalpy change ΔH accompanying the reaction _____ .

    A. is negative

    B. is positive

    C. is zero

    D. is either negative or zero

Answer: B

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40. The enthalpy change when one gram equivalent of an acid is exactly neutralized by one gram equivalent of a base in its dilute aqueous solution is known as, _____ .

    A. heat of formation

B. heat of solution

C. heat of sublimation

D. heat of neutralisation

Answer: D

41. Enthalpy change for reaction

$1/2H_2(g) + 1/2Cl_2(g) \rightarrow HCl(g)$ is called :-
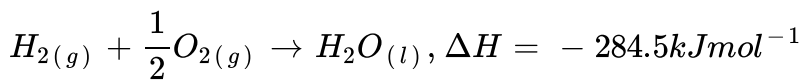
A. enthalpy of combination

B. enthalpy of vaporizaton

C. enthalpy of formation

D. enthalpy of fusion

Answer: C

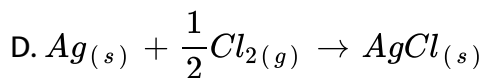**42.** The enthalpy change for the formation of 3.6 kg water is _____ .

$$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}, \Delta H = -284.5 kJmol^{-1}$$
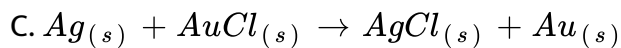
A. 284.5 kJ

B. $-284.5 kJ$

C. $-5690 kJ$

D. $-56900 kJ$

Answer: D

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43. Which of the following reactions represents enthalpy of formation of AgCl?

A. $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$

B. $AgCl_{(s)} \rightarrow Ag_{(s)} + \frac{1}{2}Cl_{2(g)}$

C. $Ag_{(s)} + AuCl_{(s)} \rightarrow AgCl_{(s)} + Au_{(s)}$

D. $Ag_{(s)} + \dfrac{1}{2}Cl_{2(g)} \rightarrow AgCl_{(s)}$

Answer: D

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44. The enthalpies of the elements in their standard states are arbitrarily

assumed to be

A. zero at 298 K

B. unit at 298 K

C. zero at all temperatures

D. zero at 273 K

Answer: A

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45. If $\Delta H_f(X)$, $\Delta H_f(Y)$, $\Delta H_f(R)$ and $\Delta H_f(S)$ denote the enthalpies of formation of X, Y, R and S respectively, the enthalpy of the reaction $X + Y \rightarrow R + S$ is given by

A. $\Delta_f H(X) + \Delta_f H(Y)$

B. $\Delta_f H(R) + \Delta_f H(S)$

C. $\Delta_f H(X) + \Delta_f H(Y) - \Delta_f H(R) - \Delta_f H(S)$

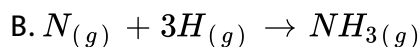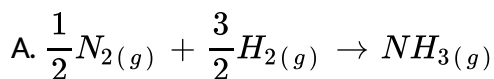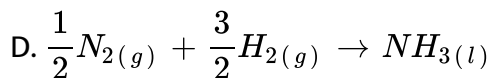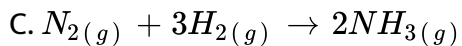D. $\Delta_f H(S) + \Delta_f H(R) - \Delta_f H(X) - \Delta_f H(Y)$

Answer: D

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46. The enthalpy of formaion of ammonia gas at 298 K is -46.11 kJ mol^{-1}. The equaiton to which this value relates is

A. $\dfrac{1}{2} N_{2(g)} + \dfrac{3}{2} H_{2(g)} \rightarrow NH_{3(g)}$

B. $N_{(g)} + 3H_{(g)} \rightarrow NH_{3(g)}$

C. $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

D. $\frac{1}{2}N_{2(g)} + \frac{3}{2}H_{2(g)} \rightarrow NH_{3(l)}$

Answer: A

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47. The heat change ΔH for the reaction

$2CO + O_2 \rightarrow 2CO_2, \Delta H = -135$ kcal is called _____ .

A. heat of formation

B. heat of reaction

C. heat of combustion

D. heat of solution

Answer: B

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48. $2.1g$ of Fe combines with S evolving $3.77KJ$. The heat of formation

of FeS in KJ/mol is

A. -1.79

B. -100.5

C. -3.77

D. -37.7

Answer: B

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**49.** Bond dissociation energy of $O_2(g)$ is $xkJmol^{-1}$. This means that

A. x kJ of energy is required to break one O_2 molecule into atom

B. x kJ of energy is required to break 1 mole of O=O bonds in gaseous

state into gaseous atoms

C. x kJ of energy is needed to convert $O_{(g)}$ into $O^-_{(g)}$

D. x kJ of energy is needed to convert 1 g of O_2 molecules into atoms

Answer: B

50. Given the following information

(i) $A + B \rightarrow C + D, \Delta H = -10.0$ kcal

(ii) $C + D \rightarrow E, \Delta H = 15.0$ kcal
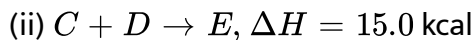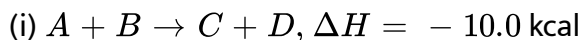
Then, ΔH for $A + B \rightarrow E$ will be _____ .

A. $+25kcal$

B. $+5kcal$

C. $-5kcal$

D. $-25kcal$

Answer: B

51. Which one of the following process is non-spontaneous?

A. Dissolution of $CuSO_4$ in water.

B. Reaction between H_2 and O_2 to form water.

C. Water flowing down hill.

D. Flow of electric current from low potential to high potential.

Answer: D

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52. The positive value of ΔS indicates that _____ .

A. the system becomes less disordered

B. the system becomes more disordered

C. the system is in equilibrium position

D. the system tends to reach at equilibrium position

Answer: B

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53. In which of the following processes does the entropy decrease?

A. Dissolution of NaCl in water.

B. The evaporation of water.

C. The conversion of CO_2 gas into dry ice.

D. When a dozen of marbles are dropped on the ground.

Answer: C

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54. Entropy is maximum in case of _____ .

A. steam

B. water at $0°C$

C. water at $4°C$

D. ice

Answer: A

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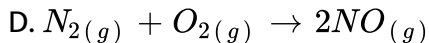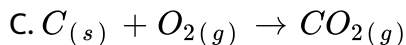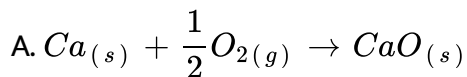
55. Highest entropy is in _____ .

A. hydrogen

B. water

C. graphite

D. mercury

Answer: A

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56. For which reaction from the following, ΔS will be maximum?

A. $Ca_{(s)} + \dfrac{1}{2}O_{2(g)} \rightarrow CaO_{(s)}$

B. $CaCO_{3(s)} \rightarrow CaCO_{(s)} + CO_{2(g)}$

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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57. For a reversible spontaneous change, ΔS is _____ .

A. $\dfrac{\Delta E}{T}$

B. $\dfrac{P\Delta V}{T}$

C. $\dfrac{q}{T}$

D. RT logK

Answer: C

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58. Which of the following statements is INCORRECT?

A. The entropy of an isolated system increases in an irreversible process.

B. The entropy of an islolated system remains unchanged in a equilibrium condition.

C. ΔS_{sys} as well as ΔS_{surr} are negative quantities.

D. Entropy of the universe never decreases.

Answer: C

59. Spontaneity of a chemical reaction is decided by the negative change in _____ .

    A. internal energy

    B. enthalpy

    C. entropy

    D. free energy

Answer: D

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60. A minus sign of the free energy change denotes that _____ .

    A. the reaction tends to proceed spontaneously

    B. the reaction is non-spontaneous

    C. the system is in equilibrium

    D. the reaction is incomplete

Answer: A

61. For melting of 3 moles of water at $0°C$, the ΔG is _____ .

A. zero

B. $+ve$

C. $-ve$

D. data insufficient

Answer: A

62. The INCORRECT option in the following table is _____.

	ΔH	ΔS	Nature of reaction
A.	$-$	$+$	spontaneous at all temperatures

	ΔH	ΔS	Nature of reaction
B.	+	−	non- spontaneous regardless of temperatures
C.	ΔH	ΔS	Nature of reaction
	+	+	spontaneous at low temperature
D.	ΔH	ΔS	Nature of reaction
	−	−	spontaneous at low temperature

Answer: C

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63. At 300 K, the reaction with which of the following values of thermodynamics parameters indicates non-spontaniety?

A. $\Delta G° = -400 kJmol^{-1}$

B. $\Delta H° = 200 kJmol^{-1}, \Delta S° = -4 Jmol^{-1}K^{-1}$

C. $\Delta H° = -200 kJmol^{-1}, \Delta S° = 4 Jmol^{-1}K^{-1}$

D. $\Delta H° = 200 Jmol^{-1}, \Delta S° = 40 Jmol^{-1}K^{-1}$

Answer: B

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64. When an ice melts, there will be _____ .

A. a decrease in enthalpy

B. a decrease in free energy

C. a decrease in internal energy

D. no change in enthalpy

Answer: B

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65. Standard enthalpy and standard entropy changes for the oxidation of ammonia at $298K$ are $-382.64kJmol^{-1}$ and $-145.6jK^{-1}mol^{-1}$ respectively. Standard Gibbs energy change for the same reaction at $298K$ is

A. $-439.3kJmol^{-1}$

B. $-523.2 kJmol^{-1}$

C. $221.1 kJmol^{-1}$

D. $-339.3 kJmol^{-1}$

Answer: D

66. The standard Gibb's free energy change, $\Delta G°$ is related to equilibrium constant, kp as

A. $K_P = -RTIn\Delta G°$

B. $K_P = \left(\dfrac{e}{RT}\right)^{\Delta G°}$

C. $K_P = -\dfrac{\Delta G°}{RT}$

D. $K_P = \dfrac{e^{-(\Delta G°)}}{RT}$

Answer: D

67. In actual practice, it is impossible to attain the low temperature (absolute zero). This lowering of temperature explains which law of thermodynamics?

    A. first

    B. second

    C. third

    D. zeroth

Answer: C

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68. Choose the CORRECT relation among the following.

    A. $\Delta G = H + TS$

    B. $\Delta U = H + PV$

C. $\Delta U = q + w^2$

D. $q_v = q_p - \Delta n_g RT$

Answer: D

Critical Thinking

1. Thermodynamics mainly deals with:

   A. the different forms of energy

   B. the quantitative relationships between the different forms of energy

   C. the energy changes that occur in physical and chemical processes

   D. all of these

Answer: D

2. Which of the following is an example of closed system?

    A. Water is a thermos flask

    B. Water in a closed beaker

    C. Water in an open flask

    D. Rain water

Answer: B

3. Human body is an example of:

    A. open system

    B. closed system

    C. isolated system

D. none of these

Answer: A

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4. The ratio of two extensive properties is equal to _____ .

A. extensive property

B. intensive property

C. internal energy

D. external energy

Answer: B

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5. Heat capacity is

A. extensive properties

B. intensive properties

C. intensive and extensive properties respectively

D. extensive and intensive properties respectively

Answer: D

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6. Which of the following is a state function as well as intensive property?

A. heat capacity

B. Internal energy

C. Temperature

D. volume

Answer: C

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7. A system is said to be in thermal equilibrium if

A. the temperature of the system is non-uniform and different from

the temperature of the surroundings

B. the mechainical properties is non-uniform throughout the system

C. the state functions of the system do not change with time

D. only pressure of the reaction is at equilibrium

Answer: C

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8. When the composition of the system does NOT change with time, then

the system is in _____ equilibrium.

A. thermal

B. chemical

C. mechanical

D. physical

Answer: B

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9. Mark the FALSE statement regarding thermodynamic processes.

A. A reversible change is a change in which the pressure remains constant.

B. An adiabatic change is a change in which the system is completely isloated in the thermal sense.

C. In an isochoric process, the volume of the system remains constant.

D. All the natural processes are irreversible processes.

Answer: A

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10. Which of the following Process is non-spontaneous

    A. Water flowing down hill.

    B. Expansion of a gas into vacuum.

    C. Evaporation of water from clothes during drying.

    D. Heat flowing from colder body to a hotter body.

Answer: D

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11. If for a thermodynamic expansion, $dq = 0$, the increase in volume is associated with _____ .

    A. decrease in pressure and increase in temperature

    B. decrease in pressure and decrease in temperature

    C. increase in pressure and decrease in temperature

D. increase in pressure and increase in temperature

Answer: B

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12. Energy equivalent to one erg, one joule and one calorie is in the order _____ .

A. 1 erg gt 1joule gt 1 calorie

B. 1 erg gt 1 calorie gt 1 joule

C. 1 calorie gt1 joule gt 1 erg

D. 1 joule gt 1 calorie gt 1 erg

Answer: C

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13. The temperature of the system decreases in an

    A. adiabatic compression

    B. isothermal compression

    C. isothermal expansion

    D. adiabatic expansion

Answer: D

14. One mole of an ideal gas expands isothermally at 300 K from 1 L to 101 L at constant pressure of 1 atmosphere. The work done during this change is _____ .

(1 L-atm =24.2 cal)

    A. $-242kcal$

    B. $-24.2kcal$

C. $-2kcal$

D. $-2.42kcal$

Answer: D

15. 2 moles of an ideal gas is expanded isothermally from $2.5 \times 10^{-3}m^3$ to $8 \times 10^{-3}m^3$ against a constant external pressure of $5 \times 10^5 Nm^{-2}$. The work done in the process is _____ .

A. $-2.525kJ$

B. $-2.750kJ$

C. $-0.2525J$

D. $-2.525J$

Answer: B

16. The work done in joules when two moles of an ideal gas are compressed at 300 K from $1dm^3$ to $100cm^3$ against a constant pressure of $3.2 \times 10^5 Nm^{-2}$ is _____ .

    A. $+14.4 \times 10^2 J$

    B. $+2.88 \times 10^2 J$

    C. $+28.8 \times 10^2 J$

    D. $+288 \times 10^2 J$

Answer: B

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17. The constant external pressure required to compress 1 mole of an ideal gas from $23 \times 10^{-3}m^3$ to $8 \times 10^{-3}m^3$ when work obtained is $9.09kJ$ at $27°C$ is _____ .

    A. $6.06 \times 10^5 Nm^{-2}$

B. $6.60 \times 10^5 Nm^{-2}$

C. $0.606 \times 10^7 Nm^{-2}$

D. $6.06 \times 10^4 Nm^{-2}$

Answer: B

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18. 1 mole of a gas occupying 3 L volume is expanded against a constant external pressure of 5 atm to a volume of 15 L. The work done by the system is _____ .

A. $-1.2L - atm$

B. $-6.07 \times 10^2 J$

C. $-1.215 \times 10^3 J$

D. $-6.078 \times 10^3 J$

Answer: D

19. 3 moles of an ideal gas is compressed from $30dm^3$ to $20dm^3$ against a constant pressure of $3.039 \times 10^5 Nm^{-2}$. The work done in calories is _____ . (1 J = 0.239 cal)

A. $+30.39cal$

B. $+72.63cal$

C. $+726.3cal$

D. $+303.9cal$

Answer: C

20. 2 moles of H_2 at 5 atm. Expanded isothermally and reversibly at $57°C$ to 1 atm. Work done is _____ .

A. $-2.303 \times 8.314 \times 330 \times \log 5 J$

B. $-2.303 \times 8.314 \times 660 \times \log 5 J$

C. $-2.303 \times 8.314 \times 660 \times \log \dfrac{1}{5} J$

D. $-2.303 \times 8.314 \times 330 \times \log \dfrac{1}{5} J$

Answer: B

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21. Two moles of an ideal gas expand spontaneouly into vacuum. The work done is :-

A. 2

B. 4

C. zero

D. infinite

Answer: C

22. w grams of a gas expand isothermally and reversibly at a given temperature T from volume V_1 to V_2 . The magnitude of work will be _____ . (assuming these gases as ideal gases)

A. $NH_3 > SO_2 > Cl_2 > H_2$

B. $SO_2 > H_2 > NH_3 > Cl_2$

C. $Cl_2 > NH_3 > SO_2 > H_2$

D. $H_2 > NH_3 > SO_2 > Cl_2$

Answer: D

23. Work done during isothermal expansion of one mole of an ideal gas form 10atm to 1atm at 300K is (Gas constant=2)

A. $-4938.8J$

B. $-4138.8J$

C. $-5744.1j$

D. $-6257.2J$

Answer: C

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24. Isothermally and reversibly one mole of neon expands from $2m^3$ to $20m^3$ and produces 831.4 J of work. The temperature at which expansion takes place is _____ .$(R = 8.314JK^{-1}mol^{-1})$

A. 434.2 K

B. 4342 K

C. 43.42 K

D. 316.42 K

Answer: C

25. The work done in ergs for a reversible expansion of n mole of an ideal gas from a volume of 20 L to 40 L at $25°C$ is_____ .

    A. $-2.303 \times 8.314 \times 298 \log_{10} 2 \times n$

    B. $-2.303 \times 0.0821 \times 298 \log_{10} 2 \times n$

    C. $-2.303 \times 0.0821 \times 298 \times \log_{10} 0.5 \times n$

    D. $-2.3030 \times 8.314 \times 10^7 \times 298 \times \log_{10} 2 \times n$

Answer: D

26. The work done when 1.6×10^{-2} kg of oxygen at 300 K are expanded isothermally and reversibly, till its volume is tripled is _____ .(

$$R = 8.314JK^{-1}\text{mole}^{-1})$$

A. $-0.6464kJ$

B. $-1.370kJ$

C. $-864.5kJ$

D. $-646.4kJ$

Answer: B

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27. In a reaction, if ΔUlt 0, then heat _____ .

A. change is zero

B. is absorbed

C. is evolved

D. change is abnormal

Answer: C

28. A system has internal energy equal to U_1, $450J$ of heat is taken out of it and $600J$ of work is done on it. The final enegry of the system will be

A. $U_1 + 1050J$

B. $U_1 - 150J$

C. $U_1 + 150J$

D. $U_1 - 1050J$

Answer: C

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29. If 2500 cal of heat is added to a system while the system does work equivalent to 3500 cal by expanding against the surrounding atmosphere, the value of ΔU for the system is _____ .

A. $-1000cal$

B. $1000cal$

C. $-6000cal$

D. $6000cal$

Answer: A

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30. The INCORRECT statement in relation to first law of thermodynamics

i.e., $\Delta U = q + W$ is, _____.

A. q is positive if heat is absorbed by the system and q is negative if

heat is released by the system.

B. ΔU is positive if internal energy of the system increases and ΔU is

negative if internal energy of the system decreases.

C. W is positive if work is done on the system and W is negative if work

is done by the system.

D. q+W is not a state function.

Answer: D

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31. In an isobaric process, _____ .

A. $q_p = 0$

B. $q_p = \Delta U$

C. $q_p = \Delta U + p_{ex} . \Delta V$

D. $q_p = \Delta U - p_{ex} . \Delta V$

Answer: C

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32. In an isochoric process the increase in internal energy is

   A. equal to the heat absorbed

   B. equal to the heat evolved

   C. equal to the work done

   D. equal to the sum of the heat absorbed and work done

Answer: A

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33. Cooling of a gas in an adiabatic expansion is due to _____ .

   A. fall in temperature

   B. Internal energy spent in doing the work

   C. energy gained in doing the work

   D. loss of energy to the surroundings

Answer: B

34. Which of the following statements is INCORRECT for the second law of thermodynamics?

A. The spontaneous flow of heat is always from higher temperature to lower temperature.

B. No machine has yet been made that has an efficiency unity.

C. Heat cannot be completely converted into equivalent work.

D. The spontaneous flow of heat is always bidirectional.

Answer: D

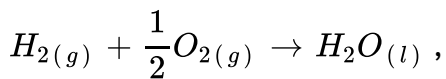**35.** Point out the WRONG statement from the following, in relation to enthalpy.

A. It is a state function.

B. It is an intensive property.

C. It is independent of the path followed for the change.

D. Its value depends upon the amount of substance in the system.

Answer: B

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36. For the following reaction at 298 K,

$$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)} \text{,}$$

Which of the following alternative is CORRECT?

A. $\Delta H = \Delta U$

B. $\Delta H > \Delta U$

C. $\Delta H < \Delta U$

D. $\Delta H = 1.5\Delta U$

Answer: C

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37. In which of the following reactions, ΔH is greater than ΔU ?

A. $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

B. $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$

C. $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

D. $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(aq)}$
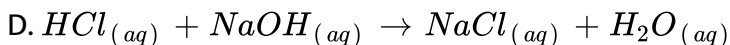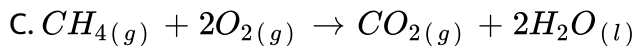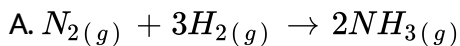
Answer: B

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38. For the gaseous reaction involving the complete combustion of iso-butane

    A. $\Delta H = \Delta U$

    B. $\Delta H > \Delta U$

    C. $\Delta H < \Delta U$

    D. $\Delta H = 0$

Answer: C

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39. A mixture of 2 moles of carbon monoxide and one mole of oxygen in a closed vessel is ignited to get carbon dioxide. If ΔH is the enthalpy change and ΔE is the change in internal energy, then :-

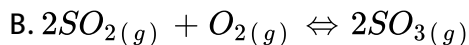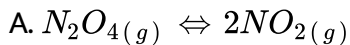   A. $\Delta H > \Delta U$

    B. $\Delta H < \Delta U$

C. $\Delta H = \Delta U$

D. the relationship depends on the capacity of the vessel

Answer: B

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

A. $N_2O_{4(g)} \Leftrightarrow 2NO_{2(g)}$

B. $2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$

C. $H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_{(g)}$

D. $H_{2(g)} + \dfrac{1}{2}O_{2(g)} \Leftrightarrow H_2O_{(l)}$
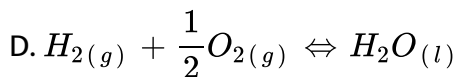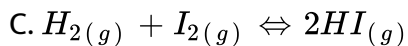
Answer: C

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41. For $CaCO_{3(s)} \Leftrightarrow CaO_{(s)} + CO_{2(g)}$ at $977°C$, ΔH=176 kJ/mol, then ΔU is _____ .

A. 180 kJ

B. 186.4 kJ

C. 165.6 kj

D. 160 kJ

Answer: C

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42. For the reaction

$C_6H_{12}(l) + 9O_2(g) \rightarrow 6H_2O(l) + 6CO_2(g)$, $\Delta H = -936.9kcal$
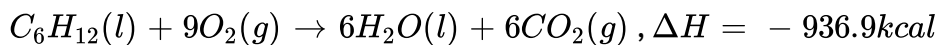
Which of the following is true ?

A. $-936.9 = \Delta H - (2 \times 10^{-3} \times 298 \times 3)\,kcal$

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

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

D. $-936.9 = \Delta U - (0.0821 \times 298 \times 3) kcal$

Answer: C

43. The heat produce during combustion of 7.8 g C_6H_6 at constant volume forming $H_2O_{(l)}$ and $CO_{2(g)}$ is 40 kJ at $27°C$. The heat of combustion at constant pressure is _____ .

A. $400 kJmol^{-1}$

B. $-36.25 kJmol^{-1}$

C. $43.74 kJmol^{-1}$

D. $-403.74 kJmol^{-1}$

Answer: D

44. The heat of combustion of solid benzoic acid at constant volume is $-321.30 kJ$ at $27°C$. The heat of combustion at constant pressure is

A. $(-321.30 - 300R)$ kJ

B. $(-321.20 + 30R)$kJ

C. $(-321.30 - 150R)$kJ

D. $(-321.30 + 900R)$ kJ

Answer: C

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45. The mathematical expression for the standard enthalpy of sublimation is given by _____ .

(Here,

$\Delta_{sub} H° = \Delta_{sublimation} H°$, $\Delta_{fus} H° = \Delta_{fusion} H°$, $\Delta_{vap} H° = \Delta_{vaporization} H$

A. $\Delta_{sub} H° = \Delta_{fus} H° - \Delta_{vap} 2H°$

B. $\Delta_{sub}H^\circ = \Delta_{fus}H^\circ - \Delta_{vap}H^\circ$

C. $\Delta_{sub}H^\circ = \Delta_{fus}H^\circ + \Delta_{vap}H^\circ$

D. $\Delta_{sub}H^\circ = \Delta_{comb}H^\circ - \Delta_{diss}2H^\circ$

Answer: C

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46. In which of the following thermochemical changes ΔH° is always negative?

A. Enthalpy of solution

B. Crystal lattice enthalpy

C. Enthalpy of atomization

D. Enthalpy of ionization

Answer: B

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47. For the transition $C_{(\text{diamond})} \rightarrow C_{(\text{graphite})}$, $\Delta H = -1.5kJ$. It follows that

A. formation of diamond is exothermic

B. formation of graphite is endothermic

C. graphite is more stable than diamond

D. diamond is more stable than graphite

Answer: C

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48. The enthalpy change when 1 g of water is frozen at $0°C$ ($\Delta_{fus} H° = -1.435$ kcal/mol) is _____ .

A. -1.435cal/g

B. -80.0cal/g

C. 80 cal/g

D. -55.6cal/g

Answer: B

49. Which of the following statements is INCORRECT about Born-Haber cycle?

A. The sequence of reactions begins with the elements in their standard states.

B. The sequence of reactions ends with the formation of the ionic compound in its standard state.

C. It can be used to determine the crystal lattice enthalpy.

D. It violates Hess's law.

Answer: D

50. When 2mole of C_2H_6 are completely burnt $-3129kJ$ of heat is liberated. Calculate the heat of formation of C_2H_6. $\Delta_f H^{\ominus}$ for CO_2 and H_2O are -395 and $-286kJ$, respectively.

A. -167kJ

B. -83.5kJ

C. $+85.98$kJ

D. 334kJ

Answer: B

51. The enthalpy of formation of ammonia is $-46.0kJmol^{-1}$. The enthalpy for the reaction $2N_2(g) + 6H_2(g) \rightarrow 4NH_3(g)$
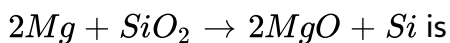
A. $-46kJmol^{-1}$

B. $46kJmol^{-1}$

C. $184kJmol^{-1}$

D. $-184kJmol^{-1}$

Answer: D

52. Values of heats of formation for SiO_2 and MgO are -48.4 and $-34.7kJ$ respectively. The heat of the reaction $2Mg + SiO_2 \rightarrow 2MgO + Si$ is

A. 21.0 kJ

B. -21.0kJ

C. 13.7 kJ

D. -13.7kJ

Answer: B

53. In the combustion of 11 g of $CO_{2(g)}$, 100 kJ of heat is liberated. Heat of combustion of $CO_{2(g)}$ is_____ .

A. $- 400$kJ

B. $+ 400$kJ

C. $- 200$kJ

D. $- 100$kJ

Answer: A

54. The heat of formations of $CO_{(g)}$ and $CO_{2(g)}$ are $- 26.4$ kcal and $- 94.0$ kcal respectively. The heat of combustion of carbon monoxide will

be _____ .

A. $+26.4$ kcal

B. -67.6 kcal

C. -20.6 kcal

D. $+52.8$ kcal

Answer: B

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55. In the combustion of 2.0 g of methane 25 kcal heat is liberated, heat of combustion of methane would be _____ .
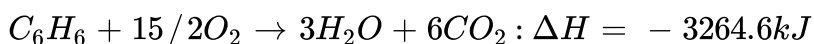
A. 100 kcal

B. 200 kcal

C. 300 kcal

D. 400 kcal

Answer: B

56. The heat evolved in combustion of benzene is given by the following

equation :

$$C_6H_6 + 15/2O_2 \rightarrow 3H_2O + 6CO_2 : \Delta H = -3264.6kJ$$

Which of the following quantities of heat will be evolved when $39g$ of

benzene are burnt in an open container ?

A. -816.15kJ

B. 1632.3 kJ

C. 6528.2 kJ

D. 2448.45 kJ

Answer: B

57. Standard enthalpies of formation of O_3, CO_3, NH_3 and HI are 142.2,-383.2,-46.2 and +25.9kJ mol^{-1} respectively. The order of their increasing stabilities will be:

A. O_3, CO_2, NH_3, HI

B. CO_2, NH_3, HI, O_3

C. O_3, HI, NH_3, CO_2

D. NH_3, HI, CO_2, O_3

Answer: C

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58. The heat of atomisation of $PH_{3(g)}$ is $228 kcal mol^{-1}$ and that of P_2H_4 is $355 kcal mol^{-1}$. Calculate the average bond energy of $P - P$ bond.

A. 102 kcal mol^{-1}

B. 51 kcal mol^{-1}

C. 26 kcal mol^{-1}

D. 204 kcal mol^{-1}

Answer: B

59. Given the bond energirs $N = N, H - H$ and $N - H$ bonds are $945, 436$ and $391 KJmol^{-1}$ respectively, the enthalpy of the follwing reactlon $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is
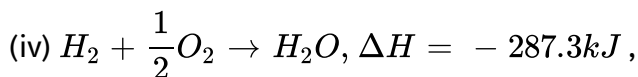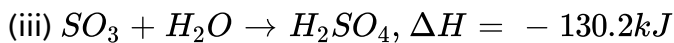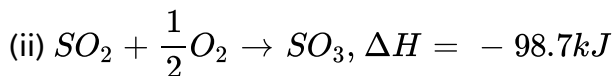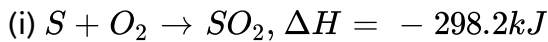
A. $- 93$kJ

B. 102 kJ

C. 90 kJ

D. 105 k

Answer: A

60. Given:

(i) $S + O_2 \rightarrow SO_2, \Delta H = -298.2 kJ$

(ii) $SO_2 + \dfrac{1}{2}O_2 \rightarrow SO_3, \Delta H = -98.7 kJ$

(iii) $SO_3 + H_2O \rightarrow H_2SO_4, \Delta H = -130.2 kJ$

(iv) $H_2 + \dfrac{1}{2}O_2 \rightarrow H_2O, \Delta H = -287.3 kJ$,

Then the enthalpy of formation of H_2SO_4 at 298 K will be _____ .

    A. -814.4kJ

    B. $+320.5$kJ

    C. -650.3kJ

    D. -933.7kJ

Answer: A

61. Calculate the enthalpy of hydrogenation of $C_2H_{4(g)}$, given that the enthalpy of formation of ethane and ethylene as -30.2kcal and $+12.5$ kcal respectively.

    A. -4.8kcal

    B. $+7.7$kcal

    C. -42.7kcal

    D. -7.7kcal

Answer: C

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62. Heat of formation of $H_2O_{(l)}$, $CO_{2(g)}$ and$C_2H_{4(g)}$ are -285.0, -399.0, and 69.9 kJ/mole respectively. The heat of combustion of ethylene is _____ .

    A. -1.4379kJ

B. $- 1437.9$ kJ

C. $- 1437$ J

D. $- 14.379$ kJ

Answer: B

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63. The combustion enthalpies of carbon, hydrogen and methane are $- 395.5 \mathrm{kJ} mol^{-1}$, $- 285.8 \mathrm{kJ} mol^{-1}$ and $- 890.4 k J mol^{-1}$ respectively at 25 . The value of standard formation enthalpy of methane at that temperature is _____ .

A. $890.4 k J mol^{-1}$

B. $- 298.8 k J mol^{-1}$

C. $- 76.1 k J mol^{-1}$

D. $- 107.7 k J mol^{-1}$

Answer: C

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64. The standard molar heat of formation of ethane, CO_2 and $H_2O_{(l)}$ are respectively -21.1, -94.1, and -68.3 kcal. The standard molar heat of combustion of ethane will be _____ .
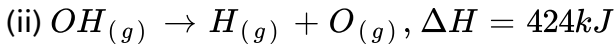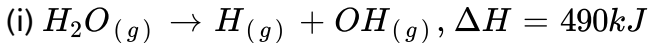
A. -372 kcal

B. 162 kcal

C. -240 kcal

D. 183.5 kcal

Answer: A

65. The $H_2O_{(g)}$ molecule dissociates as

(i) $H_2O_{(g)} \rightarrow H_{(g)} + OH_{(g)}, \Delta H = 490kJ$

(ii) $OH_{(g)} \rightarrow H_{(g)} + O_{(g)}, \Delta H = 424kJ$

The average bond energy (in kJ) for water is _____ .

A. 490

B. 424

C. 914

D. $\dfrac{914}{2}$

Answer: D

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66. Given:

$2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}, \Delta H_1 = -767kJ...(i) H_{2(g)} + \dfrac{1}{2}O_{2(g)} \rightarrow$

,
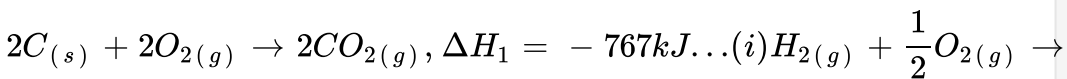
$$\Delta H_3 = -1290 kJ \text{ ....(iii)}$$

Heat of formation of acetylene is _____ .

A. 1802 kJ

B. -1802 kJ

C. 257 kJ

D. 237 kJ

Answer: C

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67. The standard ethelpy of combustion at $25°C$ of hydrogen, cyclohexene (C_6H_{10}), and cyclohexane (C_6H_{12}) are -241, -3800, and $-3920 kJmol^{-1}$ repectively. Calculate the heat of hydrogenation of cyclohexane.

A. -120 kJ

B. -1900 kJ

C. 120 kJ

D. 1900 kJ
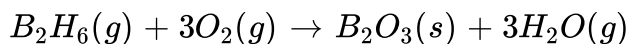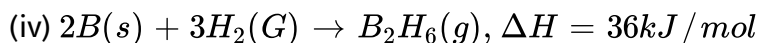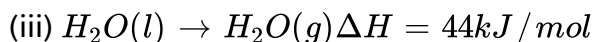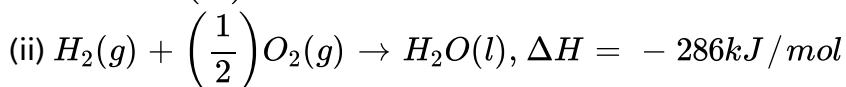
Answer: A

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68. Diborane is a potential rocket fuel which undergoes combustion according to the reaction,

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

From the following data, calculate the enthalpy change for the combustion of diborane:

(i) $2B(s) + \left(\dfrac{3}{2}\right)O_2(g) \rightarrow B_2O_3(s), \Delta H = 01273kJ/mol$

(ii) $H_2(g) + \left(\dfrac{1}{2}\right)O_2(g) \rightarrow H_2O(l), \Delta H = -286kJ/mol$

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

(iv) $2B(s) + 3H_2(G) \rightarrow B_2H_6(g), \Delta H = 36kJ/mol$
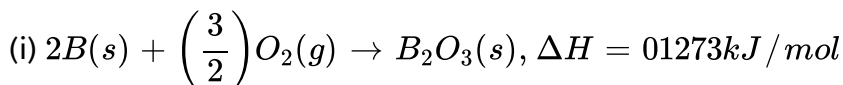
A. $+2035kJmol^{-1}$

B. $-2035kJmol^{-1}$

C. $+2167 kJmol^{-1}$

D. $-2167 kJmol^{-1}$

Answer: B

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69. The standard heat of combustion of solid boron is equal to

A. $\Delta_f H^\circ (B_2O_3)$

B. $\dfrac{1}{2}\Delta_f H^\circ (B_2O_3)$

C. $2\Delta_f H^\circ (B_2O_3)$

D. $-\dfrac{1}{2}\Delta_f H^\circ (B_2O_3)$

Answer: B

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70. When total disorder increases, the change is said to be _____ .

A. exothermic

B. non-spontaneous

C. endothermic

D. spontaneous

Answer: D

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71. For the process, normal egg $\rightarrow$ hard boiled egg, the sign of ΔS is

....

A. 0

B. $+ve$

C. $-ve$

D. ∞

Answer: C

72. In which of the following entropy decreases?

A. Crystallization of sucrose from solution

B. Rusting of iron

C. Melting of ice

D. Vaporization of camphor

Answer: A

73. The enthalpy change for the transition of liquid water to steam, Δ_{vap} H$=37.3\,$kJ mol^{-1} at 373 K. The entropy change for the process is

_____ .

A. $111.9 Jmol^{-1}K^{-1}$

B. $37.3 Jmol^{-1}K^{-1}$

C. $100 \, J\,mol^{-1}K^{-1}$

D. $74.6 \, Jmol^{-1}K^{-1}$

Answer: C

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74. The enthalpy of vaporization of a substance is 840 J per mol and its boiling point is $-173°C$. Calculate its entropy of vaporization.

A. $8.4 \, Jmol^{-1}K^{-1}$

B. $21 \, J\,mol^{-1}K^{-1}$

C. $49 \, Jmol^{-1}K^{-1}$

D. $12 \, J\,mol^{-1}K^{-1}$

Answer: A

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

A. 43.4 $JK^{-1}mol^{-1}$

B. 87.2 $JK^{-1}mol^{-1}$

C. 900 $JK^{-1}mol^{-1}$

D. Zero

Answer: A

76. 9.0 g of H_2O is vaporized at $100°C$ and 1 atm pressure. If the latent heat of vaporization of water is x J/g , then ΔS is given by _____ .

A. $\dfrac{x}{373}$

B. $\dfrac{18x}{100}$

C. $\dfrac{18x}{373}$

D. $\dfrac{1}{2} \times \dfrac{18x}{373}$

Answer: D

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77. For reaction $2Cl_{(s)} \rightarrow Cl_{2(s)}$, the signs of ΔH and ΔS respectively are _____ .

A. $+$, $-$

B. $+$, $+$

C. $-$, $-$

D. $-$, $+$

Answer: C

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78. The ΔS for the vaporization of 1 mol of water is 88.3 J/mol K. The value of ΔS for the condensation of 1 mol of vapour will be _____ .

A. 88.3 J/mol K

B. $(88.3)^2$ J/mol K

C. -88.3J/mol K

D. $\dfrac{1}{88.3}$ J/mol K

Answer: C

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79. For the change $H_2O_{(l)} \rightarrow H_2O_{(g)}$, P=1 atm, T=373 K, the free energy change ΔG=0. This indicates that _____ .

A. $H_2O_{(l)}$ is in equilibrium with $H_2O_{(g)}$

B. water boils spontaneously at373 K

C. water does not boil spontaneously at 373 K

D. condensation of water vapour occurs spontaneously at 373 K

Answer: A

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80. The INCORRECT statement among the following is _____ .

A. when ΔG=0, the system is at equilibrium

B. when $\Delta G > 0$, the process will be spontaneous

C. when $\Delta G < 0$, the process will be spontaneous

D. when$\Delta S_{\text{total}} > 0$, the process will be spontaneous

Answer: B

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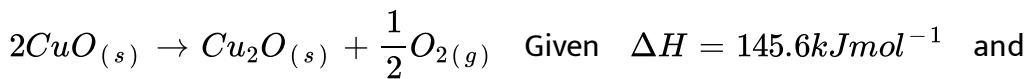
81. Which of the following conditions will apply conversion of ice into water ?

A.
Δ ΔS ΔG
$-$ $-$ Negative at low T

B.
Δ ΔS ΔG
$+$ $-$ Positive at low T

C.
Δ ΔS ΔG
$+$ $+$ Positive at low T

D.
Δ ΔS ΔG
$-$ $+$ Negative at low T

Answer: C

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82. Calculate the free energy change for the following reaction at 300 K.

$$2CuO_{(s)} \rightarrow Cu_2O_{(s)} + \frac{1}{2}O_{2(g)}$$ Given $\Delta H = 145.6 kJmol^{-1}$ and $\Delta S = 116. \, JK^{-1}mol^{-1}$

A. 110.8 kJmol^{-1}

B. 221.5 kJmol^{-1}

C. 55.4 kJmol^{-1}

D. 145.6 kJmol^{-1}

Answer: A

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83. For a reaction, ΔH= 9.08 kJmol^{-1} and ΔS=35.7 J $K^{-1}mol^{-1}$ at 298 K.

Which of the following is CORRECT for the reaction at 298 K?

A. Reversible and Isothermal

B. Reversible and Exothermic

C. Spontaneous and Endothermic

D. Spontaneous and Exothermic

Answer: C

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84. The essential condition for the feasibility of a reaction is that _____
.

A. the reaction should be exothermic

B. the entropy of products must be larger than that of reactants

C. the reaction is to be accompanied with free energy decrease

D. the reaction has to possess high activation energy

Answer: C

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85. Which of the following is the CORRECT expression for ΔS?

A. $\Delta S = \displaystyle\int_0^T \frac{C_v \cdot dT}{T}$

B. $\Delta S = \displaystyle\int_0^T \frac{C_p \cdot dT}{T}$

C. $\Delta S = \displaystyle\int_0^T C_v \cdot dT$

D. $\Delta S = \displaystyle\int_0^T C_p \cdot dT$

Answer: B

---

86. The value of entropy in the universe is

    A. increasing

    B. decreasing

    C. constant

    D. zero

Answer: A

---

87. If a refrigerator's door is kept open, will the room become cool or hot ?

A. room heated

B. room cooled

C. more amount of heat is passed out

D. no effect on room

Answer: A

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88. A reaction that takes place with the absorption of energy is _____ .

A. burning of a candle

B. Rusting of iron

C. electrolysis of water

D. respiration

Answer: C

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89. When water is added to quick lime, the reaction is

A. exothermic

B. endothermic

C. explosive

D. adiabatic

Answer: A

90. Mark the INCORRECT relationship from the following.

A. $\Delta H = \Delta U + \Delta n RT$

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

C. $W = -p \Delta V$

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

Answer: D

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91. The table given below lists the bond dissociation energy (E_{diss}) for single covalent bonds formed between C and atoms A, B, D, E.

Bond	$E_{\text{diss}}\left(\text{kcal mol}^{-1}\right)$
$C - A$	240
$C - B$	382
$C - D$	276
$C - E$	486

Which of the atoms has smallest size ?

A. D

B. E

C. A

D. B

Answer: B

92. A gas present in a cylinder fitted with a frictionless pistion expands against a constant pressure of $1atm$ form a volume of $2L$ to a volume of $6L$. In doing so, it absorbs $800J$ heat form the surroundings. Determine the increases in internal enegry of process.

A. 698.7 J

B. 1205.2 J

C. 394.8 J

D. 597.4 J

Answer: C

93. At 302 K, one mole of an ideal gas is compressed isothermally and reversibly from a pressure of 2 atm to 10 atm. The values of ΔU and q

respectively will be _____ .

A. 0, 965 cal

B. 0, -966cal

C. 966 cal, 0

D. -966cal, 0

Answer: B

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94. An athlete is given glucose of energy equivalent to 880 kJ. He utilises 50% of this gained energy in the event, in order to avoid storage of energy in the body. The weight of water he would need to perspire is _____ .

(enthalpy of evaporation of water is 44 kJ mol^{-1})

A. 18 g

B. 1.8 g

C. 1800 g

D. 180 g

Answer: D

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95. 50 ml of water takes 5 minutes to evaporate from a vessel on a heater connected to an electric source which delivers 400 W. The enthalpy of vaporization of water is _____ .

A. 40.3 kJ mol^{-1}

B. 43.2 kJ mol^{-1}

C. 16.7 kJ mol^{-1}

D. 180.4 kJ mol^{-1}

Answer: B

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1. It is a general principle that the less energy a system contains, it is

_____ .

A. less stable

B. more stable

C. unstable

D. more unstable

Answer: B

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2. Identify the intensive quantity from the following?

A. Enthalpy and temperature

B. Volume and temperature

C. Enthalpy and volume

D. Temperature and refractive index

Answer: D

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3. Identify an extensive property amongst the following.

A. Viscosity

B. Heat capacity

C. Density

D. Surface tension

Answer: B

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4. In thermodynamics, a process is called reversible when

A. surroundings and system change into each other

B. there is no boundary between system and surroundings

C. the surroundings are always in equilibrium with the system

D. the system changes into the surroundings spontaneously

Answer: C

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5. Which of the following is the largest unit?

A. Calorie

B. Joule

C. Electron volt

D. Erg

Answer: A

6. 1 L atm is equal to ____ .

    A. 12.2 cal

    B. 20.2 cal

    C. 24.2 cal

    D. 28.2 cal

Answer: C

7. Two moles of an ideal gas are allowed to expand from a volume of $10dm^3$ to $2\ m^3$ at 300 K against a pressure of 101.325 kPa. Calcualte the work done.

A. -201.6kJ

B. 13.22 kJ

C. -810.6J

D. -18.96kJ

Answer: A

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8. The work done when two mole of an ideal gas is compressed form a volume of $5m^3$ to $1dm^3$ at 300 K , under a pressure of 100 kPa is

A. 499.9 kJ

B. -499.9kJ

C. -99.5kJ

D. 42495 kJ

Answer: A

9. What is the amount of work done when 0.5 mole of methane, CH_4(g) is subjected to combustion at 300 K? (given, $R = 8.314 Jk^{-1} mol^{-1}$)

    A. $- 2494$ J

    B. $- 4988$ J

    C. $+ 4988$J

    D. $+ 2494$J

Answer: D

10. The work done during combustion of 9×10^{-2} kg of ethane, $C_2H_6(g)$ at 300 K is (Given R=8.314 J $deg^{-1} mol^{-1}$, atomic mass C = 12, H=1)

    A. 6.236 kJ

B. -6.236kJ

C. 18.71 kJ

D. -18.71 kJ

Answer: C

11. Calculate the work done during compression of 2 mol of an ideal gas from a volume of $1m^3$ to $10dm^3$ 300 K against a pressure of 100 KPa .

A. -99kJ

B. $+99$kJ

C. $+22.98$kJ

D. -22.98kJ

Answer: B

12. Calculate the wok done during combustion of 0.138 kg of ethanol, $C_2H_5OH_{(l)}$ at 300 K. Given: R = 8.314 J $K^{-1}mol^{-1}$, molar mass of ethanol = 46 g mol^{-1}.

A. -7482J

B. 7482 J

C. -2494J

D. 2494 J

Answer: B

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13. In an isothermal and reversible process, 1.6×10^{-2} kg of $O-2$ expands from $10dm^3$ to $100\ dm^3$ at 300 K. The work done in this process is _____ .

A. $+2872$J

B. -2872J

C. $+5744$J

D. -5744J

Answer: B

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14. Internal energy does NOT include _____ .

A. nuclear energy

B. rotational energy

C. vibrational energy

D. energy arising by gravitaional pull

Answer: D

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15. The internal energy change when a system goes fromk state A to B is $40kJmol^{-1}$. If the system goes from A to B by a reversible path and returns to state A by an irreversible path, what would be the net change in internal energy?

    A. 40 kJ

    B. $>$ 0 kJ

    C. $<$ 40 kJ

    D. Zero

Answer: D

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16. Mass and energy are conserved. It is demonstrated by _____ .

    A. first law of thermodynamics

B. law of conservation of energy

C. law of conservation of mass

D. modified form of 1st law of thermodynamics

Answer: D

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17. How internal energy will change due to removal of heat and work from the system?

A. decrease

B. increase

C. remain same

D. none

Answer: A

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18. Which of the following has no change in the internal energy?

A. Isobaric

B. Isochoric

C. Isothermal

D. Adiabatic

Answer: C

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19. Mathematical equation of first law of thermodynamics for isochoric process is

A. $\Delta U = q_v$

B. $-\Delta U = q_v$

C. $q = -W$

D. $\Delta U = W$

Answer: A

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20. The first law of thermodynamics for isothermal process is

A. $q = -w$

B. $\Delta U = w$

C. $\Delta U = q_v$

D. $\Delta U = -q_v$

Answer: A

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21. δU is equal to

A. isochoric work

B. isobaric work

C. adiabatic work

D. isothermal work

Answer: C

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22. Which among the following is a feature of adiabatic expansion ?

A. $\Delta V > 0$

B. $\Delta U > 0$

C. $\Delta U < 0$

D. $\Delta T = 0$

Answer: B

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23. Which among the following eqations represents the first law of thermodynamics under isobaric conditions?

A. $\Delta U = q_p - p_{ex} \cdot \Delta V$

B. $q_v = \Delta U$

C. $\Delta U = W$

D. $W = -q$

Answer: A

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24. In a closed insulated container, a liquid is stirred with a paddle to increase the temperature, which of the following is true?

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

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

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

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

Answer: C

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25. Enthalpy is equal to

    A. internal energy (U)

    B. product of pressure (P) and volume (V) of gas

    C. internal energy (U) + PV

    D. work (W) done by a system

Answer: C

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26. CORRECT representation of the heat supplied at a constant pressure and constant volume in gaseous reaction is _____ .

A. $H_2 - H_1 + U_2 - U_1 = n_2 RT - n_1 RT$

B. $H_1 - H_2 + U_1 - U_2 = n_2 RT - n_1 RT$

C. $H_2 - H_1 + U_1 - U_2 = n_2 RT - n_1 RT$

D. $H_2 - H_1 + U_2 - U_1 = n_1 RT - n_2 RT$

Answer: C

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27. If ΔH is the change in enthylpy and ΔU, the change in internal energy accompanying a gaseous reactant then

A. ΔH is always greater than ΔU

B. $\Delta H < \Delta U$ only if the number of moles of the products is greater than the number of the reactants

C. ΔH is always less than ΔU

D. $\Delta H < \Delta U$ only if the number of moles of the products is less than

the number of moles of the reactants

Answer: D

28. At constant T and P,Which of the following statements is correct for

the reaction,

$$CO(G) + \frac{1}{2}O_2(g) \rightarrow CO_2(g),$$
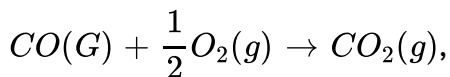
A. ΔH is independent of the physical state of the reactants of that

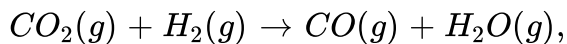conpound.

B. $\Delta H > \Delta U$

C. $\Delta H < \Delta U$

D. $\Delta H = \Delta U$

Answer: C

---

29. In the reaction

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

$$\Delta H = 2.8 kJ$$

ΔH represents

    A. -2.8kJ

    B. 2.8 kJ

    C. -5.6kJ

    D. 5.6 kJ

Answer: B

30. For the reaction

$CH_3COOH(l) + 2O_2(g) \rightleftharpoons 2CO_2(g) + 2H_2O(l)$ at $25°C$ and 1 atm.
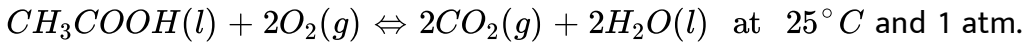
Pressure, $\Delta H = -874 kJ$. Then the change in internal energy (ΔE) is ....

A. $-874kJ$

B. $-871.53kJ$

C. $-876.47kJ$

D. $+874kJ$

Answer: A

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31. For the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$, ΔH=_____.

A. $\Delta U - RT$

B. $\Delta U - 2RT$

C. $\Delta U + RT$

D. $\Delta U + 2RT$

Answer: B

32. For the reaction

$$C_3H_8(g) + 5O_2 \rightarrow 3CO_3(g) + 4H_2O(l)$$
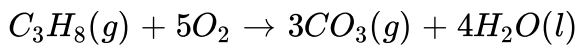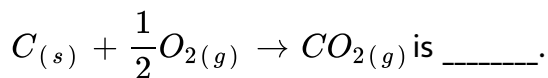
at constant temperature, $\Delta H - \Delta U$ is

A. $-RT$

B. $+RT$

C. $-3RT$

D. $+3RT$

Answer: C

33. The differnence between heat of reaction at constant pressure and

constant volume for the reaction,

$C_{(s)} + \dfrac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$ is _____.

(Assume that R=0.002 kcal and temperature = T K)

    A. T cal

    B. $-Tcal$

    C. $-\dfrac{T}{2}$cal

    D. $\dfrac{T}{2}$cal

Answer: A

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34. For the formation of HCL, _____.

    A. $\Delta H > \Delta U$

    B. $\Delta H < \Delta U$

C. $\Delta H = \Delta U$

D. none of these

Answer: C

35. What is the value of Δn in the formation of acetaldehyde from its constituent elements?

A. 0

B. -2.5

C. -1

D. -2

Answer: B

36. If the heat of combustion of carbon monoxide at constant volume and at $17°$ C is -283.3kJ, then its heat of combustion at constant pressure is

_____ .

(R = 8.314 J $kelv \in^{-1} mol^{-1}$)

A. -284.5kJ

B. 284.5 kJ

C. 384.5 kJ

D. -384.5kJ

Answer: A

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37. Enthalpy of combustion of $C_6H_{6(l)}$ at 298 K to yield $CO_{2(g)}$ and $H_2O_{(l)}$ is $\Delta H = -781.1$kcal. Calculate ΔU.
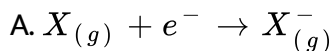
A. -708.1kcal/mol

B. -780.2 kcal/mol

C. -801.7 kcal/mol
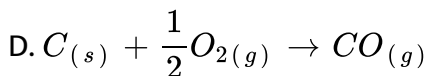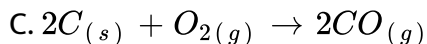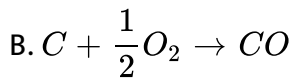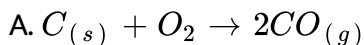
D. -810.7 kcal/mol

Answer: B

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38. The equation used to represent the electron gain enthalpy is _____.

A. $X_{(g)} + e^- \rightarrow X^-_{(g)}$

B. $X_{(s)} + e^- \rightarrow X^-_{(g)}$

C. $X_{(g)} \rightarrow + X^+_{(g)} + e^-$

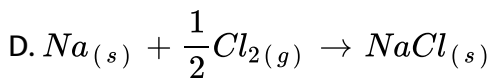D. $X_{(s)} \rightarrow + X^+_{(g)} + e^-$
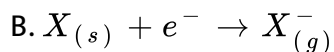
Answer: A

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39. The CORRECT equation for heat of formation of CO is _____ .

A. $C_{(s)} + O_2 \rightarrow 2CO_{(g)}$

B. $C + \dfrac{1}{2}O_2 \rightarrow CO$

C. $2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$

D. $C_{(s)} + \dfrac{1}{2}O_{2(g)} \rightarrow CO_{(g)}$

Answer: D

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40. Which among the following thermochemical equations represents formation of sodium chloride?

A. $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

B. $Na_{(s)} + 2HCl_{(g)} \rightarrow 2NaCl_{(s)} + H_{2(g)}$

C. $2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$

D. $Na_{(s)} + \dfrac{1}{2}Cl_{2(g)} \rightarrow NaCl_{(s)}$
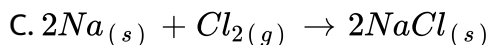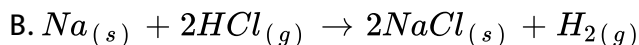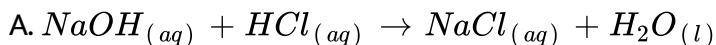
Answer: D

41. Enthalpy of formation of two compounds x and y are -84kJ and -156 kJ respectively. Which of the following statement is CORRECT?

    A. x is more stable than y.

    B. x is less stable than y.

    C. Both x and y are stable.

    D. x and y are endothermic compounds.

Answer: B

42. Heats of formation of ethane, ethylene, acetylene and CO_2 are -136.9, -66.9, -228 and -395.39 (all in kJ) respectively. The

most stable among them is _____.

A. ethane

B. ethylene

C. acetylene

D. CO_2

Answer: D

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43. Heat of formation of water is -272kJ. How much water can be decomposed by 750 kJ of heat?

A. 7.5 mol

B. 5.5 mol

C. 2.75 mol

D. 0.275 mol

Answer: C

---

44. $H_2 + Cl_2 \rightarrow 2HCl, \Delta H = -184kJ$

Then what is the amount of energy absorbed when 0.365 kg of HCl is formed?

   A. -920kJ

   B. -1840kJ

   C. -184kJ

   D. -92kJ

Answer: A

45. Heat of formation of SO_2 is $-298kJ$. What is the heat of formation of 4 g of SO_2?

    A. $+37kJ$

    B. $-37.15kJ$

    C. $+298kJ$

    D. $-18.6kJ$

Answer: D

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46. If the standard molar enthalpy of formation of $CaO_{(s)}$, $CO_{2(g)}$ and $CaCO_{3(s)}$ is -635, -393 and $-1207kJmol^{-1}$ respectively, the $\Delta_r H^\circ$ in kJ mol^{01} for the reaction

$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$ is _____ .

    A. $+965$

B. $+2235$

C. $+179$

D. -179

Answer: C

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47. The amount of heat liberated in the reaction $2PCl_5 \rightarrow 2P + 5Cl_2$ is -340 kJ. The heat of formation of PCl_5 is _____ .

A. 340 kJ

B. -340kJ

C. -170kJ

D. 170 kJ

Answer: D

48. If heat of combustion of methane is -800kJ, then heat of combustion of 4×10^{-4}kg of methane is _____ .

A. -3.2×10^4kJ

B. -800kJ

C. -280kJ

D. -20kJ

Answer: D

49. When $4g$ of iron is burnt to ferric oxide at constant pressure, $29.28 KJ$ of heat is evolved. What is the enthalpy of formation of ferric oxide (At wt. of $Fe = 56$)

A. -81.98kJ

B. -819.8kJ

C. -40.99kJ

D. $+819.8$kJ

Answer: B

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50. The heat change during the reaction 24g C and 128g S following he change $C + S_2 \rightarrow CS_2, \Delta H = 22K$ cal

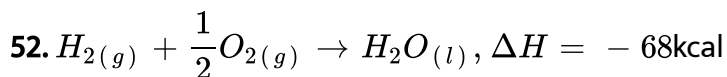A. 11 kcal

B. 32 kcal

C. 44 kcal

D. 22 kcal

Answer: C

51. The heat of combustion of carbon to CO_2 is $-395.5 kJ/mol$. The heat released upon the formation of $35.2g$ of CO_2 from carbon and oxygen gas is

A. -630kJ

B. -3.15kJ

C. -315kJ

D. $+315$kJ

Answer: C

52. $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}, \Delta H = -68$kcal

Amount of heat is liberated when 7.2 g of water is decomposed is _____ .
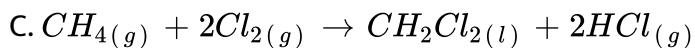
A. − 27.2kcal

B. 27.2 kcal

C. 55.4 kcal

D. − 55.4kcal

Answer: B

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53. For which one of the following equations is $\Delta_r H^\circ$ equal to $\Delta_f H^\circ$ for the products (s)?

A. $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

B. $N_{2(g)} + O_{3(g)} \rightarrow N_2O_{3(g)}$

C. $CH_{4(g)} + 2Cl_{2(g)} \rightarrow CH_2Cl_{2(l)} + 2HCl_{(g)}$

D. $Xe_{(g)} + 2F_{2(g)} \rightarrow XeF_{4(g)}$
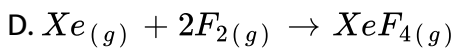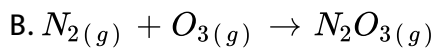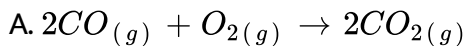
Answer: D

54. Energy required to dissociate $4g$ of gaseous hydrogen into free gaseous atoms is $208Kcal$ at $25°C$

The bond energy of $H-H$ bond will be

A. 104 kcal

B. 10.4 kcal

C. 1040 kcal

D. 104 kcal

Answer: A

55. Identify the invalid equation

A. $\Delta H = \sum H_{products} - \sum H_{reactants}$

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

C. $\Delta H^\circ_{(reaction)} = \sum H^\circ_{(product\ bonds)} - \sum H^\circ_{(reactant\ bonds)}$

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

Answer: C

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56. The $H - H$ bond energy is $430KJmol^{-1}$ and $Cl - Cl$ bond energy is $240KJmol^{-1}$. ΔH for HCl is $-90KJ$. The $H - Cl$ bond energy is about

A. 180 kJmol^{-1}

B. 360 kJmol^{-1}

C. 213 kJmol^{-1}

D. 425 kJmol^{-1}

Answer: D

57. $\Delta_f H$ of HCl is _____.

    A. $- 185$kcal

    B. 185 kcal

    C. 92.5 kcal

    D. $- 92.5$kcal

Answer: C

58. The bond energies of C-C,C=C, H-H and C-H bonds are 350 kJ mol^{-1}, 600 kJmol^{-1}, 400 kJmol^{-1} and 410 kJmol^{-1} respectively. The enthalpy of hydrogenation of ethane is _____.

    A. $- 170$kJ

B. -260kJ
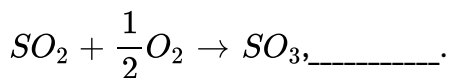
C. -400kJ

D. -450kJ

Answer: A

59. The values of heat of formation of SO_2 and SO_3 and $-298.2kJ$ and -98.2kJ. The heat of reaction of the following reaction will be: $SO_2 + \dfrac{1}{2}O_2 \to SO_3,$_____.

A. -200kJ

B. -356.2kJ

C. $+200$kJ

D. -396.2kJ

Answer: C

60. From the thermochemical reactions, C(graphite)

$+1/2O_2 \rightarrow CO, \Delta H = -110.5\text{KJ}$
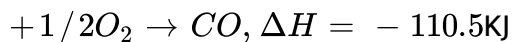
$CO + 1/2O_2 \rightarrow CO_2, \Delta H = -283.2$ KJ the heat of reaction of

C(graphite) $+O_2 \rightarrow CO_2$ is :

A. -393.7kJ

B. $+393.7\text{kJ}$

C. -172.7kJ

D. $+172.7\text{kJ}$

Answer: A

61. Heat of hydrogenation of ethylene is X and that of acetylene is Y,

change in enthalpy when acetylene is hydrogenated to ethylene is

_____.

A. X-Y

B. 2Y-X

C. Y-X

D. X-2Y

Answer: C

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62. Given:

$$C_{(\text{Graphite})} + O_{2(g)} \rightarrow CO_{2(g)}, \Delta_r H^\circ = -393.5 kJmol^{-1} H_{2(g)} + \frac{1}{2}O_2$$

$$CO_{2(g)} + 2H_2O_{(l)} \rightarrow CH_{4(g)} + 2O_{2(g)}, \Delta_r H^\circ = +890.3 kJmol^{-1}$$
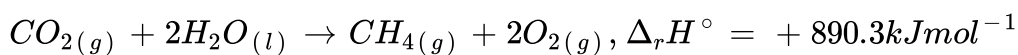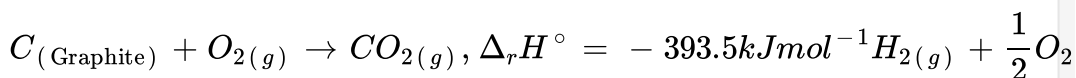
Based on the above thermochemical equations, the value of $\Delta_r H^\circ$ at 298

K for the reaction $C_{(\text{graphite})} + 2H_{2(g)} \rightarrow CH_{4(g)}$ will be _____ .

A. $+74.8 kJmol^{-1}$

B. $+144.0 kJmol^{-1}$

C. $-74.8 kJmol^{-1}$

D. $-144.0 kJmol^{-1}$

Answer: C

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63. Assuming enthalpy of combustion of hydrogen at 273 K is -286kJ and enthalpy of fusion of ice at the same temperature to be $+6.0$kJ, calculate enthalpy change during formation of 100 g of ice.

A. $+1622$kJ

B. -1622kJ

C. $+292$kJ

D. -292kJ

Answer: B

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64. Theoretical basis of Hess's law is _____.
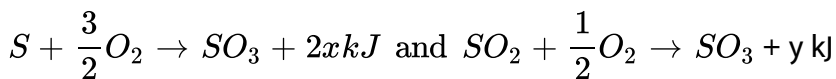
A. Kirchhoff's law

B. law of conservation of energy

C. heat of ionization of strong acids and strong bases

D. variation in heat of reaction

Answer: B

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65. In the reactions,

$$S + \frac{3}{2}O_2 \rightarrow SO_3 + 2xkJ \text{ and } SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 + \text{y kJ}$$

Heat of formation of SO_2 is _____.

A. y-2x

B. x-y

C. 2x-y

D. 2x+y

Answer: A

---

66. Given that $C + O_2 \rightarrow CO_2, \Delta H^\circ = -xKJ$ and $2CO + O_2 \rightarrow 2CO_2, \Delta H^\circ = -yKJ$ The enthalpy of formation of carbon monoxide will be

A. $\dfrac{y - 2x}{2}$

B. y+2x

C. 2x-y

D. $\dfrac{2x - y}{2}$

Answer: A

67. The enthalpies of combustion of carbon and carbon monoxide are -393.5 and -283 kJ mol^{-1} respectively. The enthaly of formation of carbon monoxide per mole is :

A. 676.5

B. -676.5

C. -110.5

D. 110.5

Answer: C

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68. For which among the following reactions change in entrophy is less than zero ?

A. Sublimation of iodine

B. Dissociation of hydrogen

C. Formation of water

D. Thermal decomposition of calcium carbonate

Answer: C

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69. The unit of entropy is

A. $Jmol^{-1}$

B. $JK\,mol^{-1}$

C. $J\,mol^{-1}K^{-1}$

D. $J^{-1}K^{-1}mol^{-1}$

Answer: C

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70. What is the entropy change (in $JK^{-1}mol^{-1}$) when one mole of ice is converted into water at $0°C$?

(The enthalpy change for the conversion of ice to liquid water is $6.0KJmol^{-1}$ at $0°C$)

A. 21.98

B. 20.13

C. 2.013

D. 2.198

Answer: A

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71. One mole of $NaCl_{(s)}$ on melting absorbed 30.5 kJ of heat and its entropy is increased by 28.8 JK^{-1}. The melting point of NaCl is _____.

A. 1059 K

B. 30.5 K

C. 28.8 K

D. 28800 K

Answer: A

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72. One mole of water at $100°C$ is converted into steam at $100°C$ at a constant pressure of 1 atm. The change in entropy is _____. (heat of vaporization of water at $100°C$=540 cal/g)

A. 8.74 cal $mol^{-1}K^{-1}$

B. 18.76 cal $mol^{-1}K^{-1}$

C. 24.06 cal $mol^{-1}K^{-1}$

D. 26.06 cal $mol^{-1}K^{-1}$

Answer: D

73. If the enthalpy of vaporisation of water is $186.5 Jmol^{-1}$, then entropy of its vaporisation will be

A. 0.5 kJ $K^{-1}mol^{-1}$

B. 1.0 kJ $K^{-1}mol^{-1}$

C. 1.5 kJ $K^{-1}mol^{-1}$

D. 2.0 kJ $K^{-1}mol^{-1}$

Answer: A

74. 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. $\Delta S = RT\ln\left(\dfrac{P_i}{P_f}\right)$

B. $\Delta S = nR \ln \left(\dfrac{P_f}{P_i} \right)$

C. $\Delta S = nR \ln \left(\dfrac{P_i}{P_f} \right)$

D. $\Delta S = nRT \ln \left(\dfrac{P_f}{P_i} \right)$

Answer: C

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75. The standard entropies of $CO_{2(g)}, C_{(s)},$ and $O_{2(g)}$ are 213.5, 5.740 and 205 JK^{-1} respectively. The standard entropy of formation of CO_2 is _____.

A. 2.76 JK^{-1}

B. 2.12 JK^{-1}

C. 1.12 JK^{-1}

D. 1.40 JK^{-1}

Answer: A

76. Considering entropy (S) as a thermodynamics parameter, the criterion for the spontaneity of any process is

A. $\Delta S_{system} > 0$ only

B. $\Delta S_{surroundings} > 0$ only

C. $\Delta S_{system} + \Delta S_{surroundings} > 0$

D. $\Delta S_{system} - \Delta S_{surroundings} > 0$

Answer: C

77. The criterion for a spontaneous process is

A. $\Delta G > 0$

B. $\Delta G < 0$

C. $\Delta G = 0$

D. $\Delta S_{total} < 0$

Answer: B

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78. Adsorpton of gases on solid surface is generally exothermic because :

A. enthalpy is positive

B. entropy decrease

C. entropy increases

D. free energy increase

Answer: B

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79. Ice and water are at equilibrium at 0°C , ΔH=4 kJ/mol for the process,

$H_2O_{(s)} \rightarrow H_2O_{(l)}$ which of the following is CORRECT?

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

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

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

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

Answer: D

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80. Which of the following statements of correct for the spontaneous adsoption of a gas?

A. ΔS is negative and therefore, ΔH should be highly positive.

B. ΔS is negative and therefore, ΔH should be highly negative.

C. ΔS is positive and therefore, ΔH should be negative.

D. ΔS is positive and therefore, ΔH should also be highly positive.

Answer: B

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81. The correct thermodnamic conditions for the spontaneous reaction at all temperature is:

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: A

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82. An endotthermic reaction is non-spontaneous at freezing point of water and becomes feasible at its boiling point, then:

A. ΔH is -ve, ΔS is +ve

B. ΔH and ΔS both are +ve

C. ΔH and ΔS both are-ve

D. ΔH is +ve, ΔS is -ve

Answer: B

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83. The standard enthalpy or the decomposition of N_2O_5 to NO_2 is 58.04 kJ and standard entropy of this reaction is 176.7 J/K. The standard free energy change for this reaction at $25°$ C is_____.

A. -5.38kJ

B. 5.38 kJ

C. 5.38 J

D. -538kJ

Answer: B

84. For the reaction $Ag_2O(s) \rightarrow 2Ag(s) + 1/2O_2(g)$ the value of $\Delta H = 30.56KJmol^{-1}$ and $\Delta S = 66JK^{-1}mol^{-1}$. The temperature at which the free energy change for the reaction will be zero is :-

A. 373 K

B. 413 K

C. 463 K

D. 493 K

Answer: C

85. At what temperature, a reaction will be at equilibrium at 1 atm if ΔH and ΔS are 30.58 kJ and 66.1 Jk^{-1} respectively? These values do not change with temperature in any significant fashion.

A. 420.2 K

B. 462.6 K

C. 429 K

D. 642 K

Answer: B

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86. The values of ΔH and ΔS of a certain reaction are $-400kJmol^{-1}$ and $-20kJmol^{-1}K^{-1}$ respectively. The temperature below which the reaction is spontaneous is _____.

A. 100 K

B. $20°$ C

C. 20 K

D. $120°$ C

Answer: C

---

87. Which of the following statements is correct for a reversible process in a state of equilibrium ?

A. $\Delta G = -2.30$ RT logK

B. $\Delta G = 2.30$ RT log K

C. $\Delta G° = -2.30$ RT log K

D. $\Delta G° = 2.30$ RT log K

Answer: C

88. If $K > 1.0$, then the value of ΔG° will be _____ .
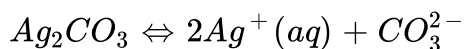
A. 1

B. zero

C. negative

D. positive

Answer: C

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89. Using the Gibbs energy change, $\Delta G^\circ = +63.3kJ$, for the following reaction,

$$Ag_2CO_3 \Leftrightarrow 2Ag^+(aq) + CO_3^{2-}$$

the K_{sp} of $Ag_2CO_3(s)$ in water at $25^\circ C$ is

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

A. 3.2×10^{-26}

B. 8.0×10^{-12}

C. 2.9×10^{-3}

D. 7.9×10^{-2}

Answer: B

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90. For the reaction:

$$X_2O_4(l) \rightarrow 2XO_2(g)$$
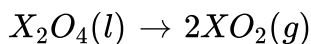
$\Delta U = 2.1 cal, \Delta S = 20 cal K^{-1} at 300K$

Hence ΔG is

A. $-2.7 kcal$

B. $-27 kcal$

C. 9.3 kcal

D. $-9.3 kcal$

Answer: A

---

91. Entropy of a perfect crystalline solid at absolute zero is

A. positive

B. negative

C. zero

D. not definite

Answer: C

---

92. Which law of thermodynamics helps in calculating the absolute entropies of various substances at different temperatures?

A. First law

B. Second law

C. Third law

D. Zeroth law

Answer: C

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93. A heat engine absorbs heat Q_1 at temperature T_1 and Q_2 at temperature T_2 . Work done by the engine is $(Q_1 + Q_2)$. This data:

A. violates 1st law of thermodynamics

B. violates 1st law of thermodynamics if Q_1 is $-ve$

C. violates 1st law of thermodynamics of $Q_2 is - ve$

D. does not violate 1st law of thermodynamics

Answer: D

94. What is the free energy change in dissolving one mole of NaCl with its lattice energy and hydration energy of 777.8 kJ mol^{-1} and $-774 kJ mol^{-1}$ respectively at $25°$ C?

(Given: $\Delta S = 0.043 kJK^{-1}mol^{-1}$)

A. $-18.2 kJmol^{-1}$

B. $-36.4 kJmol^{-1}$

C. $-9.1 kJmol^{-1}$

D. $18.2 kJmol^{-1}$

Answer: C

95. For the reaction $X_2Y_{4(l)} \rightarrow 2XY_{2(g)}$ at 300 K the values of ΔU and ΔS are 2 kCal and 20 Cal K^{-1} respectively. The value of ΔG for

the reaction is _____.

A. $- 3400$Cal

B. 3400 Cal

C. $- 2800$Cal
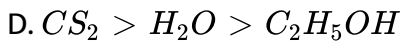
D. 2000 Cal

Answer: C

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96. The heats of vaporization of H_2O, C_2H_5OH and CS_2 are 40.6 kJmol^{-1}, $38.6kJmol^{-1}$ and $26.8kJmol^{-1}$ respectively. The strength of intermolecular forces in these liquids is in the order of _____.

A. $H_2O > C_2H_5OH > CS_2$

B. $CS_2 > C_2H_5OH > H_2O$

C. $H_2O > CS_2 > C_2H_5OH$

D. $CS_2 > H_2O > C_2H_5OH$

Answer: A

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

A. 35.8 JK^{-1}

B. 32.3 JK^{-1}

C. 42.3 JK^{-1}

D. 38.3 JK^{-1}

Answer: D

1. The enthalpy change for a reaction does not depend upon:

    A. physical states of reactants and products

    B. use of different reactants for obtaining the same product

    C. nature of intermediate reaction steps

    D. difference in initial and final temperatures of involved substances

Answer: C

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2. The internal energy change when a system goes fromk state A to B is $40 kJmol^{-1}$. If the system goes from A to B by a reversible path and returns to state A by an irreversible path, what would be the net change in internal energy?

    A. 40 kJ

B. > 40 kJ

C. < 40 kJ

D. 0

Answer: D

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3. Following gases have equal masses at the same temperature, pressure and volume. The maximum work is done by _____.

A. oxygen

B. nitrogen

C. hydrogen

D. fluorine

Answer: C

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4. The standard enthalpy of formation $\left(\Delta_f H^\circ\right)$ at $298K$ for methane $\left(CH_{4(g)}\right)$ is $-74.8kJmol^{-1}$. The additional information required to determine the average energy for $C - H$ bond formation would be :

A. the dissociation energy of H_2 and enthalpy of sublimation of C

B. latent heat of vaporization of methane

C. the first four ionisation energies of carbon and electron gain

   enthalpy of hydrogen

D. the dissociation energy of H_2 molecule

Answer: A

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5. $(\Delta H - \Delta U)$ for the formation of carbon monoxide (CO) from its elements at $298K$ is

$\left(R = 8.314K^{-1}mol^{-1}\right)$

A. -1238.78 J/mol

B. 1238.78 J/mol

C. -2477.57 J/mol

D. 2477.57 J/mol

Answer: B

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6. Identify the correct statement regarding a spontaneous process.

    A. Lowering of energy in the reaction process is the only criterion for

        spontaneity.

    B. For a spontaneous process in an isolated system, the change in

        entropy is positive.

    C. Endothermic processes are never spontaneous.

    D. Exothermic processes are always spontaneous.
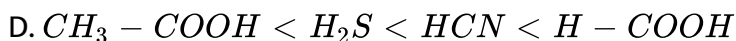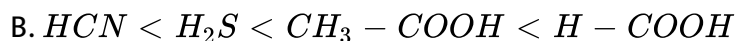
Answer: B

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

A. 1000 K

B. 1250 K

C. 500 K

D. 750 K

Answer: D

8. The heats of neutralisation of $CH_3 - COOH$, H-COOH,HCN and H_2S are -13.2, -13.4, -2.9, and -3.8 kcal/equivalent respectively. The CORRECT increasing order of acid strength is_____.

A. $HCOOH < CH_3COOH < H_2S < HCN$

B. $HCN < H_2S < CH_3 - COOH < H - COOH$

C. $HCOOH < CH_3COOH < HCN < H_2S$

D. $CH_3 - COOH < H_2S < HCN < H - COOH$

Answer: B

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9. The bond dissociation energy of gaseous H_2, Cl_2 and HCl are 104, 58 and $103 kcal mol^{-1}$ respectively. The enthalpy of formation for HCl gas will be

A. 59 kcal

B. -265kcal

C. -22kcal

D. -29.5 kcal

Answer: C

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10. The difference between the heats of reaction at constant pressure and

a   constant   volume   for   the   reaction

$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$ at $25°C$ in kJ is

A. -7.43

B. $+3.72$

C. -3.72

D. $+7.43$

Answer: A

11. Given standard enthalpy of formation of $CO\left(-110\text{KJ mol}^{-1}\right)$ and $CO_2\left(-394\text{KJ mol}^{-1}\right)$. The heat of combustion when one mole of graphite burns is

   A. -110kJ

   B. -284kJ

   C. -394kJ

   D. -504kJ

Answer: C

12. $H_2(g) + 1/2O_2(g) = H_2O(l), \Delta H_{298K} = -68.32$ Kcal. Heat of vapourisation of water at 1 atm and $25°C$ is 10.52 Kcal. The standard heat of formation (in Kcal) of 1 mole of water vapour at $25°C$ is

A. -78.84

B. 78.84

C. $+57.80$

D. -57.80

Answer: D

13. The heat change at constant volume for the decomposition of silver (I) oxide is found to be $30.66kJ$. The heat change at constant pressure will be

A. 30.66 kJ

B. > 30.66 kJ

C. < 30.66 kJ

D. unpredictable

Answer: B

---

14. Which of the following value of ΔH_f° represent that the product is least stable ?

    A. -94.0kcal/mole

    B. -231.6 kcal/mole

    C. $+21.4$kcal/mole

    D. `+64.8 kcal/mole

Answer: D

---

15. The enthalpy change (ΔH) for the process $N_2H_{4(g)} \rightarrow 2N_{(g)} + 4H_{(g)}$ is 1724 kJ mol^{-1}. If the bond energy of N-H

bond in NH_3 is 391 kJmol^{-1}. What is the bond energy of N-N bond in N_2H_4?
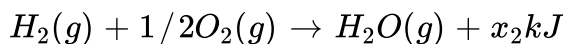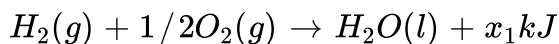
A. 320 kJmol^{-1}

B. 160 kJmol^{-1}

C. 391 kJmol^{-1}

D. 1173 kJmol^{-1}

Answer: B

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16. For the two equations given below:

$$H_2(g) + 1/2O_2(g) \rightarrow H_2O(l) + x_1 kJ$$

$$H_2(g) + 1/2O_2(g) \rightarrow H_2O(g) + x_2 kJ$$

Select the correct answer:

A. $a_1 + a_2 = 0$

B. $a_1 = a_2$

C. $a_2 > a_1$

D. $a_2 < a_1$

Answer: D

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17. For an endothermic reaction, where ΔH represents the enthalpy of reaction in $kJmol^{-1}$, the minimum value for the energy of activation will be

A. less than ΔH

B. zero

C. more than ΔH

D. equal to ΔH

Answer: D

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18. The entropy chnge for a non-spontaneous reaction is 140 J/K.mole at 298 K. The reaction is_____.

    A. reversible

    B. irreversible

    C. exothermic

    D. endothermic

Answer: D

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19. The entropy change for a certain non-spontaneous reaction is 150 J/K.mol. at 298 K. The minimum value of ΔH for the reaction is _____.
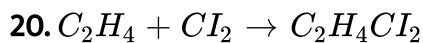
    A. $- 44.7$kJ

    B. 44.7 kJ

C. 0.448 kJ

D. -0.448kJ

Answer: B

---

20. $C_2H_4 + CI_2 \rightarrow C_2H_4CI_2$

$\Delta H = -270.6kJmol^{-1}K^{-1}, \Delta S = -139J$

a. Is the reaction favoured by entropy, enthalpy both or none?

b. Find ΔG if $T = 300K$.

A. -312.3kJ/mol

B. 312.3 kJ/mol

C. -228.9kJ/mol

D. 228.9 kJ/mol

Answer: C

21. Which of the following does NOT result in increase in the entropy?

A. Crystallization of sucrose from solution

B. Rusting of iron

C. Conversion of ice to water.

D. Vaporization of camphor

Answer: A

22. The standard heats of formation for $CCl_{4(g)}$, $H_2O_{(g)}$, $CO_{2(g)}$ and $HCl_{(g)}$ are -25.5, -57.8, -94.1 and $-22.$ kcal respectively. ΔH for the reaction, $CCl_{4(g)} + 2H_2O_{(g)} \rightarrow CO_{2(g)} + 4HCl_{(g)}$ at 298 K is_____.

A. -199.5kcal

B. $- 265.8$kcal

C. $- 32.9$kcal

D. $- 41.4$kcal

Answer: D

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23. For an isothermal free expansion of an ideal gas,

A. $\Delta S_{sys} > \Delta S_{surr}$

B. $\Delta S_{sys} < \Delta S_{surr}$

C. $\Delta S_{sys} = \Delta S_{surr}$

D. $\Delta S_{sys} = - \Delta S_{surr}$

Answer: D

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24. Work done on 3 moles of a perfect gas at 27° C, if it is compressed reversibly and isothermally from a pressure of $1.01 \times 10^5 Nm^{-2}$ to $5.05 \times 10^6 Nm^{-2}$ is _____.

A. -9375×10^3J

B. 1.95×10^4J

C. -1.95×10^4J

D. 2.9277×10^4J

Answer: D

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25. Isothermally and reversibly, one mole of argon expands from $2m^3$ to $20m^3$ and produces 831.4 J of work. The temperature at which expansion takes place is _____ .$(R = 8.314 JK^{-1}mol^{-1})$

A. 4342 K

B. 43.42 K

C. 434.2 K

D. 316.42 K

Answer: B

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