CHEMISTRY

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

CHEMICAL THERMODYNAMICS AND ENERGETIC

Example

1. A system consisting of 1 mole of an ideal gas undergoes an isothermal expansion at 25° from 1.0 bar to a lower pressure while generating 100 J of work. What is the final pressure of the system if the external pressure of the system is constant of 0.1 bar?

A. 1.23 bar

B. 0.712 bar

C. 0.958 bar

D. 0.664 bar

Answer: B

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2. Two litres of an ideal gas at a pressure of 10 atm expands isothermally at $25^{\circ}C$ into a vacuum until its total volume is 10 litres. How much heat is absorbed and how much work is done in the expansion ?

A. 0,0

B. 0,2

C. 3,0

D. 1.5,1.5

Answer: A

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3. 1g of graphite is burnt in a bomb calorimeter in excess of oxygen at 298 K and 1 atmospheric pressure according to the equation

C (graphite)$+O_2(g) \rightarrow CO_2(g)$

During the reaction, temperature rises from 298 K to 299 K. If the heat capacity of the bomb calorimeter is 20.7kJ/K, what is the enthalpy change for the above reaction at 298 K and 1 atm?

A. $-2.48 \times 10^2 kJ \quad mol^{-1}$

B. $2.48 \times 10^2 \text{kJ} \quad mol^{-1}$

C. $-5.46 \times 10^2 \text{kJ} \quad mol^{-1}$

D. $5.46 \times 10^2 \text{kJ} \quad mol^{-1}$

Answer: A

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4. For a reaction, $\Delta H = 10000 \ \text{kJ} \ mol^{-1}$ and $\Delta S = 25 \ \text{kJ} \ k^{-1} mol^{-1}$. The minimum temperature, above which the reaction would be spontaneous is

A. $127^\circ C$

B. $400^\circ C$

C. $75^\circ C$

D. $410^\circ C$

Answer: A

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5. Calculate ΔG^Θ for the conversion of oxygen to ozone, $\left(\frac{3}{2}\right)O_2(g) \Leftrightarrow O_3(g) at 298K$, of K_p for this conversion is 2.47×10^{-29}.

A. $1.63 kJ mol^{-1}$

B. $164 kJ mol^{-1}$

C. $16.3 kJ mol^{-1}$

D. $1630 kJ mol^{-1}$

Answer: B

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Exercise 1

1. Thermodynamics is not concerned about....

A. energy changes involvedin a chemical reaction

B. the extent to which a chemical reaction proceeds

C. the rate at which a reaction proceeds

D. the feasibility of a chemical reaction

Answer: C

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2. Which of the following statement is correct?

A. The presence of reacting species in a covered beaker is an example of open system

B. There is an exchange of energy as well as matter between the systemm and the surroundings in a closed systemm

C. the presence of reactants in a closed vessel made up of copper is an example of a closed system

D. The presence of reactants in a thermos flask or any other closed insulated vessel is an example of a closed system.

Answer: C

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3. Which of the following is the intensive quantity?

A. Enthalpy and temperature

B. Volume and temperature

C. Enthalpy and volume

D. Temperature and refractive index

Answer: D

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4. A thermodynamics state function is a quantity

A. used to determine heat changes

B. whose value is independent of path

C. used to determine pressure volume work

D. whose value depends on temperature only

Answer: B

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5. During the adiabatic process,

A. pressure is maintained constant

B. gas is isothermally expanded

C. there is a perssure volume work

D. The system changes heat with surrounding

Answer: C

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6. If W is the amoung of work done by the system and q is the amount of heat supplied to the system, identify the type of the system.

A. isolated system

B. closed system

C. open system

D. system with thermally conducting walls

Answer: B

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7. Which of the following is an intensive property?

A. Temperature

B. Viscosity

C. Surface tension

D. All of these

Answer: D

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8. Which of the following is the correct option for the free expansion of an ideal gas under adiabatic condition?

A. $q = 0, \Delta T < 0, W \neq 0$

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

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

D. $q = 0, \Delta T = 0, W = 0$

Answer: D

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9. Five moles of a gas is put through a series of changes as shown graphically in a cyclic process. The process during $A \to B, B \to C$ and $C \to A$ respectively are

A. isochoric, isobaric, isothermal

B. isobatic, isochoric,isothermal

C. isothermal, isobaric, isochoric

D. isochoric, isothermal, isobaric

Answer: A

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10. A process in which the system does not exchange heat with the surroundings is known as

A. isothermal

B. isobaric

C. isochoric

D. adiabatic

Answer: D

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11. In which process net work done is zero ?

A. Cyclic

B. Isobaric

C. Adiabatic

D. Free expansion

Answer: D

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12. Which of the given properties depends on the manner in which a change is brought about?

(i) ΔE

(ii) q

(iii) W

A. Only (i)

B. Both (i) and (ii)

C. Both (ii) and (iii)

D. Only (iii)

Answer: C

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13. Which is correct for an endothermic reaction ?

A. ΔH is positive

B. ΔH is negative

C. ΔE is negative

D. ΔH is zero

Answer: A

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14. If a refrigerator's door is opened then, we get

A. room heated

B. room cooled

C. more amount of heat is passed out

D. no effect on room

Answer: C

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15. Match the columns for the different types of system in thermomdynamics.

A. 1-A,2-B,3-C

B. 1-B,2-A,3-C

C. 1-A,2-C,3-A

D. 1-C,2-B,3-A

Answer: B

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16. The change in the internal energy for an isolated system at constant volume is

A. $\Delta U \neq 0$

B. $\Delta U = \Delta E + \Delta W$

C. $\Delta U = 0$

D. none of these

Answer: C

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17. If a gas, at constant temperature and pressure expands, then its

A. internal energy increases and then decreases

B. internal energy increases

C. internal energy remains the same

D. internal energy decreases

Answer: C

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18. Select the correct statement(s).

A. $q = +ve$ means heat is transferred from the system to the surroundings

B. q=-ve means heat is transferred from the surroundings to the system

C. q=+ve means heat is transferred from the suroundings to the system

D. all of these

Answer: C

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19. Which of the following statement/expression is/are correct?

A. $\Delta U = W_{\text{adiabatic}}$

B. $W_{ad} = +ve$, when work is done on the system

C. $W_{ad} = -ve$, when work is done by the system

D. All of these

Answer: D

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20. In a process, $701J$ of heat is absorbed by a system and $394J$ of work is done by the system. What is the change in internal energy for the process?

A. $-464J$

B. $+464J$

C. $+307J$

D. $-307J$

Answer: C

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21. Which of the following is the correct expression for the change in internal energy used for general case?

A. $\Delta U = q$

B. $\Delta U = w$

C. $\Delta U = q + W$

D. $\Delta U = W_{\text{adiabatic}}$

Answer: C

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22. The change in internal energy for an isolated system at constannt volume is

A. zero

B. -2.18 erg

C. $+4.27$ erg

D. $+2.78$ erg

Answer: A

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23. For the equilibrium, $A(g) \Leftrightarrow B(g)$, ΔH is $-40kJ/mol$, if the ratio of the activation energies of the forward (E_f) and reverse (E_b) reactions is 2/3, then

A. $E_f = 80kJ/mol, E_b = 120kJ/mol$

B. $E_f = 60kJ/mol, E_b = 100kJ/mol$

C. $E_f = 30kJ/mol, E_b = 70kJ/mol$

D. $E_f = 70kJ/mol, E_b = 30kJ/mol$

Answer: A

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

A. For an isothermal process, q=+W

B. for an isochoric process, $\Delta U = -q$

C. For an adiabatic process, $\Delta U = -W$

D. For a cyclic process, q=-W

Answer: D

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25. Select the correct statement/expression about the graph.

A. it is an irreversible compression

B. pressure is not constant and changes in finite step during compression from initial volume, V_i to final volume, V_f

C. Both (a) and (b)

D. none of these

Answer: C

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26. If 1 mole of an ideal gas exapands isothermally at $37^{\circ}C$ from 15 L to 25L, the maximum work obtained is

A. 12.87 L atm

B. 6.43 L atm

C. 8.57 L atm

D. 2.92 L atm

Answer: A

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27. An ideal gas expands from $10^{-3}m^3$ to $10^{-2}m^3$ at 300 K against a constant pressure of $10^5 Nm^{-2}$. The workdone is

A. $-900J$

B. $-900J$

C. $270J$

D. $900kJ$

Answer: A

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28. For an ideal gas, pressure (p) and interal energy (E) per unit volume are related as

A. $p = \frac{2}{3}E$

B. $p = \frac{E}{2}$

C. $p = \frac{3}{2}E$

D. $p = 2E$

Answer: A

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29. How many joules of heat are absorbed when 70.0 g of water is completely vaporised at its boiling point?

A. 23352 J

B. 7000 J

C. 15813 J

D. 158200 J

Answer: D

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30. Change in internal energy when $4kJ$ of work is done on the system and $1kJ$ of heat is given out of the system is

A. $+1kJ$

B. $-5kJ$

C. $+5kJ$

D. $+3kJ$

Answer: D

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31. A system absorb $600J$ of heat and work equivalent to $300J$ on its surroundings. The change in internal energy

A. 300 J

B. 400 J

C. 500 J

D. 600 J

Answer: A

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32. Select the correct formula about the change in enthalpy.

A. $\Delta_r H$=(Sum of enthalpies of reactants)-(Sum of enthalpies of products)

B. $\Delta_r H$ = (Sum of enthalpies of products)-(Sum of enthalpies of reactants)

C. $\Delta_r H$ = (Difference of enthalpies of products)-(Difference of enthalpies of reactants)

D. $\Delta_r H$ = (Difference of enthalpies of reactants)-(Difference of enthalpies of products)

Answer: B

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33. Select the correct formula for $\Delta_{sol} H^-$.

A. $\Delta_{sol}H^{\ominus} = \Delta_{\text{lattice}}H^{\ominus} - \Delta_{hyd}H^{\ominus}$

B. $\Delta_{sol}H^{\ominus} = \Delta_{\text{lattice}}H^{\ominus} + \Delta_{hyd}H^{\ominus}$

C. $\Delta_{\text{lattice}}H^{\ominus} = \Delta_{sol}H^{\ominus} + \Delta_{hyd}H^{\ominus}$

D. $\Delta_{hyd}H^{\ominus} = \Delta_{sol}H^{\ominus} + \Delta_{\text{lattice}}H^{\ominus}$.

Answer: B

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34. Which of the following statement is correct regarding melting of ice?

A. It is the phase transformation

B. It takes places at constant pressure and temperature

C. Both (a) and (b)

D. none of these

Answer: C

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35. Which of the following is not an endothermic reaction?

A. Dehydrogenation

B. Ethane to ethene

C. Combustion of propane

D. Change of chlorine molecule into chlorine atoms

Answer: C

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36. Given : $S_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow SO_{3(g)} + 2XKcal$

$SO_{2(s)} + \frac{1}{2}O_{2(g)} \rightarrow SO_{3(g)} + YKcal$

The heat of formation of SO_2 is : $-$

A. $x + y$

B. $x - y$

C. $2x - y$

D. $2x + y$

Answer: C

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37. In the given reaction, $Na(s) \rightarrow Na(g)$

The enthalpy of atomisation is same as the

A. enthalpy of dissociation

B. enthalpy of sublimation

C. enthalpy of association

D. enthalpy of vaporisation

Answer: B

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38. In the following process,

$H_2(g) \rightarrow 2H(g), \quad \Delta_{H-H}H^{\ominus} = 435.0 \text{ kJ } mol^{-1}$ the enthalpy change involved is the

A. bond dissociation enthalpy of H-H bond

B. bond association enthalpy of H-H bond

C. mean bond dissociation enthalpy of H-H bond

D. mean bond association enthalpy of H-H bond

Answer: A

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

A. increases

B. decreases

C. does not change

D. fluctuates indefinitely

Answer: A

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40. ΔU° for combustion of methane is -X kJ mol^{-1}. The value of ΔH° is

A. $= \Delta U^\circ$

B. $> \Delta U^\circ$

C. $< \Delta U^\circ$

D. $= 0$

Answer: C

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41. Two moles of an ideal gas is expanded isothermally and reversibly from 1L to 10L at 300 K. the enthalpy change (in kJ) for the process is

A. 11.4

B. -11.4

C. 0

D. 4.8

Answer: C

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42. For the given reaction,

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

Select the correct option for $\Delta_r H$.

A. $[H_m(CO_2, g) + 2H_m(O_2, g)] - [2H_m(H_2O, l) + H_m(CH_4, g)]$

B. $[2H_m(O_2, g) + H_m(CH_4, g)] - [H_m(CO_2, g) + 2H_m(H_2O, l)]$

C. $[H_m(CO_2, g) + 2H_m(H_2O, l)] - [H_m(CH_4, g) + 2H_m(O_2, g)]$

D. $[H_m(CO_2, g) + H_m(H_2O, l)] - [H_m(CH_4, g) + 2H_m(O_2, g)]$

Answer: C

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43. What is Δn_g for the combusion of 1 mole of benzene, when both reactants and products are gases at 298K

A. 0

B. 1

C. 0.5

D. 1.5

Answer: C

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44. Enthalpy change for the reaction,

$4H(g) \rightarrow 2H_2(g)$ is -869.5 kJ.

The dissociation energy of H-H bonds is

A. $+217.4kJ$

B. $-434.8kJ$

C. $-869.6kJ$

D. $+434.8kJ$

Answer: D

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45. The heat energy required to ionise the following molecules is given as follows

$N_2(g) \xrightarrow{\Delta H_1} H_2^{\oplus}(g), O_2(g) \xrightarrow{\Delta H_2} O_2^{+}(g)$

$Li_2(g) \xrightarrow{\Delta H_3} Li_2^{\oplus}(g), C_2(g) \xrightarrow{\Delta H_4} C_2^{\oplus}(g)$

The correct decreasing order of energy in terms of heat

A. $\Delta H_1 > \Delta H_3 > \Delta H_2 > \Delta H_4$

B. $\Delta H_2 > \Delta H_3 > \Delta H_1 > \Delta H_4$

C. $\Delta H_3 > \Delta H_4 > \Delta H_1 > \Delta H_2$

D. $\Delta H_3 > \Delta H_1 > \Delta H_4 > \Delta H_2$

Answer: C

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46. Given that $\Delta H_f(H) = 218kJ/mol$, express the H-H bond energy in kcal/mol

A. 52.15

B. 911

C. 104

D. 52153

Answer: C

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47. Calculate the difference between ΔE and ΔH for the following reaction at $27^{\circ} C$ (in kcal)

$C(\text{graphite}) + 2H_2(g) \rightarrow CH_4(g)$

A. -0.6

B. -1.2

C. $+0.6$

D. $+1.2$

Answer: C

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48. The sublimation energy of $l_2(s)$ is 57.3 kJ/mol and the enthalpy of fusion is 15.5 kJ/mol. The enthalpy of vaporisation of l_2 is

A. 41.8 kJ/mol

B. -41.8 kJ/mol

C. 72.8 kJ/mol

D. -72.8 kJ/mol

Answer: A

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49. The enthalpy of reaction, $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$ is ΔH_1 and that of $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ is ΔH_2. Then

A. $\Delta H_1 < \Delta H_2$

B. $\Delta H_1 + \Delta H_2 = 0$

C. $\Delta H_1 > \Delta H_2$

D. $\Delta H_1 = \Delta H_2$

Answer: A

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50. The heat of neutralisation is highest for the reaction between

A. $NH_4OH - CH_3COOH$

B. $HNO_3 - NH_4OH$

C. $NaOH - CH_3COOH$

D. $HCl - NaOH$

Answer: D

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51. The H-H bond energy is 430 kJ mol^{-1} and Cl-Cl bond energy is 240 kJ mol^{-1}, ΔH and HCl is -90kJ. The H-Cl bond energy is about

A. 180 kJ mol^{-1}

B. 360 kJ mol^{-1}

C. 213 kJ mol^{-1}

D. 425 kJ mol^{-1}

Answer: D

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52. Heat of formation off SO_2 is -298 kJ. What is the heat of combustion of 4 g of S?

A. $+37kJ$

B. $-37.25kJ$

C. $+298kJ$

D. 18.6 kJ

Answer: B

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53. The quantity of heat measured for a reaction in a bomb calorimeter is equal to

A. ΔG

B. ΔH is negative

C. $p\Delta V$

D. ΔE

Answer: D

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54. Heat capacity (C_p) is an extensive property but specific heat (C) is an intensive property. What will be the relation between C_p and C for 1 mole of water?

A. $+4.18JK^{-1}$

B. $-4.18JK^{-1}$

C. $-75.3JK^{-1}$

D. $+75.3JK^{-1}$

Answer: D

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55. The volume of gas is reduced to half from its original volume. The specific heat will . .. .

A. reduced to half

B. be doubled

C. remains constant

D. increase four times

Answer: C

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56. The gaseous mixture containing 2 moles of each of two ideal gases $A\left(C_V, m = \frac{3}{2}R\right)$ and $B\left(C_V, m = \frac{5}{2}R\right)$. Find out the average molar heat capacity at constant volume.

A. 8R

B. 3R

C. 2R

D. R

Answer: C

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57. Calculate the difference between C_p and C_V for 10 mole of an ideal gas.

A. 83.14 J

B. 8.314 J

C. 831.4 J

D. 0.8414 J

Answer: A

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58. Entropy is

A. a thermodynamic concept

B. a state function

C. independent of path

D. all of these

Answer: D

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59. Which of the following statement is false regarding entropy?

A. The greater the disorder in an isolated system, the lower is the entropy

B. the entropy change can be attributed to rearrangement of atoms or ions from one pattern in the reactant of another (in the product)

C. Decrease of regularity in structure would mean increase in entropy

D. The gase ous state is the state of highest entropy

Answer: A

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60. From an isolated system, $\Delta U = 0$, what will be ΔS?

A. 0

B. > 0

C. < 0

D. ≥ 0

Answer: B

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61. For the reaction, $2Cl(g) \rightarrow Cl_2(g)$, what are the signs of ΔH and ΔS?

A. $+, +$

B. $+, -$

C. $-, -$

D. $-, +$

Answer: C

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62. The standard molar entropy of $H_2O(l)$ is 70 $JK^{-1}mol^{-1}$. Standard molar entropy of $H_2O(s)$ is

A. more than 70 $JK^{-1}mol^{-1}$

B. less than 70 $JK^{-1}mol^{-1}$

C. equal to 70 $JK^{-1}mol^{-1}$

D. none of these

Answer: B

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63. Select the incorrect expression from the following expressions.

A. $\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surr}}$

B. $\Delta S_{\text{surr}} = \dfrac{\Delta H_{\text{surr}}}{T} = -\dfrac{\Delta H_{\text{sys}}}{T}$

C. $\Delta S_{\text{total}} < 0$ (spontaneous process)

D. $\Delta G = \Delta - T\Delta S$

Answer: C

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64. Find our the entropy change in surroudings when 1 mole of $H_2O(l)$ is formed under standard conditions $\Delta_f H^{\ominus} = -286 \text{ kJ } mol^{-1}$

A. 959.7 $JK^{-1}mol^{-1}$

B. 286 $JK^{-1}mol^{-1}$

C. $-959.7 \quad JK^{-1} \quad mol^{-1}$

D. $-286JK^{-1}mol^{-1}$

Answer: A

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65. Unit of entropy is

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

B. $J \quad mol^{-1}$

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

D. $JK \quad mol^{-1}$

Answer: A

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66. One mole of which o the following has the highest entropy?

A. Liquid nitrogen

B. Hydrogen gas

C. Mercury

D. Diamond

Answer: B

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67. In a reversible process, $\Delta S_{sys} + \Delta S_{\text{surr}}$ is

A. > 0

B. < 0

C. ≥ 0

D. $= 0$

Answer: D

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68. According to second law of thermodynamics, a process (reaction) is spontaneous, if during the process

A. $\Delta S_{\text{universe}} > 0$

B. $\Delta S_{\text{universe}} = 0$

C. $\Delta H_{\text{system}} = 0$

D. $\Delta S_{\text{universe}} = \Delta S_{\text{system}}$

Answer: A

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69. The second law of thermodynamics says that in a cyclic process

A. work cannot be converted into heat

B. heat cannot be convertd into work

C. work cannot be completely converted into heat

D. heat cannot be completely converted into work

Answer: D

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

A. Exothermic and decreasing disorder

B. Endothermic and increasing disorder

C. Exothermic and increasing disorder

D. Endothermic and decreasing disorder

Answer: C

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

A. 0.1 R

B. 2.303 R

C. 10.0 R

D. 100.0 R

Answer: B

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72. Which of the following does not have zero entropy even at absolute zer0o?

$CO, CO_2, NaCl, NO$

A. CO, CO_2

B. CO, NO

C. $CO_2, NaCl$

D. $NaCl$

Answer: B

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

A. $\Delta H(-ve), \Delta S(+ve)$

B. $\Delta H(-ve), \Delta S-(ve)$

C. $\Delta H+(ve), \Delta S+(ve)$

D. none of these

Answer: A

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74. 2 moles of ann ideal gas at $27^{\circ}C$ are expanded reversibly from 2L to 20 L. find entropy change. (R=2 cal/mol K)

A. 0

B. 4

C. 9.2

D. 92

Answer: C

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75. At $27^{\circ} C$, latent heat of fusion of a compound is 2930 J/mol. Entropy change during fusion is

A. 9.77 J/mol K

B. 0.977 J/mol K

C. 9.07 J/mol K

D. none of these

Answer: A

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76. In evaporation of water, ΔH and ΔS are

A. $+, +$

B. $+, -$

C. $-, -$

D. $-, +$

Answer: A

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77. Which one of the following is correct?

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

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

C. $\Delta S = \frac{1}{T}[\Delta G - \Delta H]$

D. $\Delta S = \frac{1}{T}[\Delta H - \Delta G]$

Answer: D

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78. The standard free energy change (ΔG°) is related to equilibrium constant (K) as

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

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

C. $\Delta G^{\circ} =$ 2.303 RT log K

D. $\Delta G^{\circ} =$ -2.303 RT ln K

Answer: A

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79. Find the value of ΔG° if the $\Delta H^{\circ} = -29.8$ kcal and $\Delta S^{\circ} = -0.100$ kcal K^{-1} is given at 298K.

A. 0

B. 1

C. 2

D. 4

Answer: A

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80. If $K < 1, 0,$ what will be the value of ΔG°?

A. Zero

B. 1

C. Positive

D. Negative

Answer: C

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81. Find the equilibrium constant K_p in $\log K_p$ if the standard free energy change of a reaction $\Delta G^\circ = -115kJ$ at 298K is

A. 2.303

B. 13.83

C. 2.016

D. 20.16

Answer: D

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82. The equilibrium constant for a reaction is 10. what will be the value of ΔG°? Given, $R = 8.314JK^{-1}mol^{-1}, T = 300K.$

A. $-574.414Jmol^{-1}$

B. $-5744.14Jmol^{-1}$

C. $-57.4414 Jmol^{-1}$

D. $57441.4 Jmol^{-1}$

Answer: B

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

A. $-\Delta G = W_{\text{compression}}$

B. $-\Delta G = W_{\text{expansion}}$

C. $\Delta G = \ -W_{\text{expansion}} = W_{\text{non-expansion}}$

D. $\Delta G = W_{\text{expansion}}$

Answer: B

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84. At 1 atm pressure, $\Delta S = 75JK^{-1}mol^{-1}$, $\Delta H = 30kJ \quad mol^{-1}$, the temperature of the reaction at equilibrium is

A. 400 K

B. 330 K

C. 200 K

D. 110 K

Answer: A

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85. Under which of the following sets of conditions, ΔG is always negative?

A. $\Delta H = -ve$ and $\Delta S = +ve$

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

C. $\Delta H = +ve$ and $\Delta S = +ve$

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

Answer: A

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86. The gibbs free energy for a reversible reaction at equilibrium is

A. positive

B. negative

C. zero

D. can be positive or negative

Answer: C

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87. Consider the reaction,

$C(s) + O_2(g) \rightarrow CO_2(g) + 393.5kJ$, the signs of $\Delta H, \Delta S$ and ΔG respectively are

A. $+, -, -$

B. $-, +, +$

C. $-, -, -$

D. $-, +, -$

Answer: D

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88. The free energy for a reaction having $\Delta H = 31400cal, \Delta S = 32$ cal $K^{-1}mol^{-1}$ at $1000^\circ C$ is

A. $-9336cal$

B. $-7386cal$

C. $-1936cal$

D. $+9336cal$

Answer: A

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Exercise 2

1. The free energy change for the following reaction are given below:

$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l), \Delta G^\circ = -1234J$

$C(s) + O_2(g) \rightarrow CO_2(g), \Delta G^\circ = -394kJ$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta G^\circ = -237kJ$

what is the standard free energy change for the reaction?

$H_2(g) + 2C(s) \rightarrow C_2H_2(g)$

A. $-209kJ$

B. $-2259kJ$

C. $+2259kJ$

D. $209kJ$

Answer: D

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2. When one mole of monoatomic ideal gas at T temperature undergoes adiabatic change under a constant external pressure of 1 atm, change in volume is from 1 L to 2L. The final temperature in kelvin would be

A. $\frac{T}{2^{(2/3)}}$

B. $T + \frac{2}{3 \times 0.0821}$

C. T

D. $T - \frac{2}{3 \times 0.0821}$

Answer: A

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3. The heat of neutralisation of a strong acid and a strong alkali is 57.0 kJ mol^{-1}. The heat released when 0.5 mole of HNO_3 solution is mixed with 0.2 mole o KOH is

A. 57.0 kJ

B. 11.4 kJ

C. 28.5 kJ

D. 34.9 kJ

Answer: B

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4. A cylinder of gas is assumed to contain 11.2 kg of butane (C_4H_{10}). If a normal family needs 20000 kJ of energy per day, the cylinder will last in (given that ΔH for combustion of butane is -2658 kJ)

A. 20 days

B. 25 days

C. 26 days

D. 24 days

Answer: C

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5. Calculate the enthalpy change on freezing of 1.0 mole of water at $10.0^\circ C$ to ice at $-10.0^\circ C$

$[\Delta_{\text{fus}}H = 6.03kJmol^{-1}$ at $0^\circ C]$

$C_p[H_2O(l)] = 75.3Jmol^{-1}K^{-1}$

$C_p[H_2O(s)] = 36.8Jmol^{-1}K^{-1}$

A. $-753Jmol^{-1}$

B. $-368Jmol^{-1}$

C. $-7.151kJmol^{-1}$

D. $-6.03kJmol^{-1}$

Answer: C

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

A. 43.4 J/mol K

B. 87.2 J/mol K

C. 900 J/mol K

D. zero

Answer: A

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7. The heat of atomisation of methane and ethene are 360 kJ/mol and 620 kJ/mol, respectively. The longest wavelenth of light capable of breaking

the C-C bond is (Avogadro number $= 6.02 \times 10^{23}$, $h = 6.62 \times 10^{-34}$ Js)

A. $2.48 \times 10^{3} nm$

B. $1.49 \times 10^{3} nm$

C. $2.49 \times 10^{5} nm$

D. $2.48 \times 10^{4} nm$

Answer: D

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8. In the given figure,

What does the above figure represent?

A. Calorimeter for measuring heat changes at constant volume

B. Bom calorimeter for measuring heat changes at constant volume

C. Calorimeter for measuring heat changes at constant pressure

D. none of these

Answer: C

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9. Energies requried to break the individual C-H bonds in each successive step differ

$CH_4(g) \rightarrow CH_3(g) + H(g), \Delta_{\text{bond}}H^{\ominus} = 439 \text{ kJ } mol^{-1}$

$CH_2(g) \rightarrow CH(g) + H(g), \Delta_{\text{bond}}H^{\ominus} = 439kJmol^{-1}$

$CH(g) \rightarrow C(g) + H(g), \Delta_{bond}H^{\ominus} = 347kJmol^{-1}.$

In such cases we use

A. bond association enthalpy of C-H bond, $\Delta_{C-H}H^{\ominus} = 416kJmol^{-1}$

B. Bond association enthalpy of C-H bond, $\Delta_{C-H}H^{\ominus} = 1665kJmol^{-1}$

C. mean bond enthalpy of C-H bond, $\Delta_{C-H}H^{\ominus} = 416kJmol^{-1}$

D. none of these

Answer: C

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10. Use the given data to calculate the resonance energy of N_2O. $\left(\Delta_f H^{\ominus} \text{ of } N_2O = 82kJmol^{-1}\right)$

Bond energy of N=O $\rightarrow 607kJmol^{-1}$

Bond energy of O=O $\rightarrow 498kJmol^{-1}$

bond energy of N=N $\rightarrow 418kJmol^{-1}$

Bond energy of $N \equiv N \rightarrow 946kJmol^{-1}$

Choose the correct option.

A. 82 kJ mol^{-1}

B. $-88kJ\ mol^{-1}$

C. -82 kJ mol^{-1}

D. $+88kJmol^{-1}$

Answer: B

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11. A reaction takes place in a several sequential steps A,B,C and D. the vlaue of enthalpy change for sequential steps are p,q,r and s respectively. If A and C have equal values of enthalpy change with total enthalpy change is t, then choose the incorrect statement among the following.

A. $q = r$

B. $q + r = t - (s + p)$

C. $2q = t - (s + p)$

D. $q + r = p + s$

Answer: D

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12. The pressure volume work for an ideal gas can be calculated by using the expression $W = -\int_{V_i}^{V_f} p_{ext} dV$. The work can also be calculated

from the pV-plot by using the area under the curve within the specified limits. When an ideal gas is compressed (a) reversibly or (b) irreversibly from volume V_i to V_f. choose the correct option.

A. $W_{(\text{reversible})} = W_{(\text{irreversible})}$

B. $W_{(\text{reversible})} < W_{(\text{irreversible})}$

C. $W_{(\text{reversible})} > W_{(\text{Irreversible})}$

D. $W_{(\text{reversible})} = W_{(\text{irreversible})} + p_{ext} \cdot \Delta V$

Answer: B

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13. Different stages of the thermodynamic process are given in the pV diagram.

Calculate the work done is each stage.

A. $W_{AB} = -7200J, W_{BC} = 0, W_{CD} = 2400J, W_{AD} = 0$

B. $W_{AB} = +7200J, W_{BC} = 0, W_{CD} = -2400, W_{AD} = 0$

C. $W_{AB} = 0, W_{BC} = -7200J, W_{CD} = 0, W_{AD} = 2400J$

D. $W_{AB} = , W_{BC} = , W_{CD} = , W_{AD} = -2400$

Answer: A

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14. The (i)____of a syste can be changed by transfer of heat from the surrounding to the system of cive-verse without expenditure of (ii)____. Identify (i) and (ii) in order to complete the above statement.

A. (i)-enthalpy, (ii)-work

B. (i)-internal energy, (ii) heat

C. (i)-enthalpy, (ii)- heat

D. (i)-internal energy, (ii)-work

Answer: D

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15. Molar enthalpy change for vaporisation of 1 mole of water at 1 bar and $100^\circ C$ is 41 kJ mol^{-1} (If water vapour is assumed to be perfect gas). Find out of the internal energy change. If 1 mole of water is vaporised at 1 bar pressure and $100^\circ C$.

A. $+37.904 kJ mol^{-1}$

B. $-37.904 kJ mol^{-1}$

C. $44.096 kJ mol^{-1}$

D. $-44.096 kJ mol^{-1}$

Answer: A

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16. The heat of reaction for

$C_{10}H_8(s) + 12O_2(g) \rightarrow 10CO_2(g) + 4H_2O(l)$

at constant volume is -1228.2 kcal at $25^{\circ}C$. The heat of reaction at constant pressure and same temperature is

A. -1228.2 kcal

B. -1229.3 kcal

C. -1232.9 kcal

D. -1242.6 kcal

Answer: B

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17. The graph expresses the various steps of the system containing 1 mole of gas. Which type of process system has when it moves from C to A?

A. Isochoric

B. Isobaric

C. Isothermal

D. Cyclic

Answer: B

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

A. 400 kJ mol^{-1}

B. 300 kJ mol^{-1}

C. 20 kJ mol^{-1}

D. none of these

Answer: D

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19. The equilibrium constannt of a reaction is 0.008 at 298 K. the standard energy change of the reaction at the same temperature is

A. $-11.96kJ$

B. $-5.43kJ$

C. $-8.46kJ$

D. $+11.96kJ$

Answer: D

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20. The ratio of heats liberated at 298 K from the combustion of one kg of coke and by burning water gas obtained from 1kg of coke is (assume coke to be 100% carbon). (Given: Enthalpies of combustion of CO_2, CO and H_2 are 393.5 kJ, 285 kJ, 285 kJ respectively all at 298K)

A. $0.79:1$

B. $0.69:1$

C. $0.86:1$

D. $0.96:1$

Answer: B

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21. The value of ΔH for cooling 2 moles of an ideal monoatomic gas from $225^\circ C$ to $125^\circ C$ at constant pressure will be [given $C_p = \frac{5}{2}R$]

A. 250 R

B. $-500R$

C. $500R$

D. $-250R$

Answer: B

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22. Which of the following statement is correct for the spontaneous adsorption 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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23. The value of enthalpy change (ΔH) for the reaction $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$, at $27^\circ C$ is $-1366.5 \text{ kJ } mol^{-1}$. The value of internal energy change for the above reaction at this temperature will be

A. $-1371.5kJ$

B. $-1369.0kJ$

C. $-1364.5kJ$

D. $-1361.5kJ$

Answer: C

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24. A plot of ln k against $\frac{1}{T}$ (abscissa) is expected to be a straight line with intercept on coordinate axis equal to

A. $\frac{\Delta S^\circ}{2.303R}$

B. $\frac{\Delta S^\circ}{R}$

C. $-\frac{\Delta S^\circ}{R}$

D. $R \times \Delta S^\circ$

Answer: B

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25. A container of 1.0 L capacity filled with 1.0 mole of ideal gas is connected to an evacuated vessel to 9L. Calculate change in entropy. (R=1.987 cal.)

A. 0.188 cal $\cdot K^{-1}mol^{-1}$

B. 0.4576 $\cdot K^{-1}mol^{-1}$

C. 4.576 cal $\cdot K^{-1}mol^{-1}$

D. 4.366 cal $\cdot K^{-1}mol^{-1}$

Answer: D

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26. In which of the following reactions, the enthalpy is the least?

A. $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

B. $HCl + NH_4OH \rightarrow NH_4Cl + H_2O$

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

D. $HCN + NH_4OH \rightarrow NH_4CN + H_2O$

Answer: D

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27. For a particular reversible reaction at temperature T, ΔH and ΔS were found to be +ve. If T_e is the temperature at equilibrium, the reaction would be spontaneous when

A. $T_e > T$

B. $T > T_e$

C. T_e is 5 times T

D. $T = T_e$

Answer: B

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28. $C(s) + O_2(g) \rightarrow CO_2(g), \Delta H = -94$ kcal

$2CO(g) + O_2 \rightarrow 2CO_2, \Delta H = -135.2$ kcal

The heat of formation of $CO(g)$ is

A. -26.4 kcal

B. 41.2 kcal

C. 26.4 kcal

D. 229.2 kcal

Answer: A

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29. The heat of formations for $CO_2(g), H_2O(l)$ and $CH_4(g)$ are -400 kJ mol^{-1}, -280 kJ mol^{-1} and -70 kJ mol^{-1}, respectively. The heat of combustion of CH_4 in kJ mol^{-1} is

A. 890

B. -160

C. -890

D. -90

Answer: C

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30. A hypothetical reaction $A \rightarrow 2B$, proceeds through following sequence of steps

(i) $A \rightarrow C, \Delta H = q$

(ii) $C \rightarrow D, \Delta H = v$

(iii) $\frac{1}{2}D \rightarrow B, \Delta H = x$

Then, the heat of reaction is

A. $q - v + 2x$

B. $q + v - 2x$

C. $q + v + 2x$

D. $q + 2v - 2x$

Answer: C

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31. ΔH for the reaction,

$C(\text{graphite}) + 2H_2(g) \rightarrow CH_4(g)$

at 298 K and 1 atm is -17900 cal. The ΔE for the above conversion should be

A. -17900 cal

B. 17900 cal

C. 17304 cal

D. -17304 cal

Answer: D

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32. The decreasing order of bond dissociation energies of C-C,C-H and H-H bonds is

A. $H-H>-C-H>-C-C-$

B. $-C-C->-C-H>H-H$

C. $-C-H>-C-C->H-H$

D. $-C-C->H-H>-C-H$

Answer: A

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33. If the end energies of H-H, Br-Br and H-Br are 433, 1992 and 364 kJ mol^{-1} respectively, then ΔH° for the reaction, $H_2(g)+Br_2(g)\rightarrow 2HBr(g)$ is

A. $-261kJ$

B. $+103kJ$

C. $+261kJ$

D. $-103kJ$

Answer: D

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34. At $27^\circ C$ one mole of an ideal gas is compressed isothermally and reversibly from a pressure of 2 atm to 10 atm. The value of ΔE and q are (R=2 cal)

A. 0,-965.84 cal

B. $-965.84cal,\ -865.58cal$

C. $+865.58cal,\ -865.58cal$

D. $+965.84cal,\ +865.58cal$

Answer: A

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35. The internal energy change when a system goes from state A to B is 40 kJ/mol. I the system goes from A to B by a reversible path and return to state A by a irreversible path, what would be the net change in internal energy?

A. 40 kJ

B. $> 40kJ$

C. $< 40kJ$

D. zero

Answer: D

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36. Given,

$2Fe + \frac{3}{2}O_2 \rightarrow Fe_2O_3, \Delta H = -193.4kJ, Mg + \frac{1}{2}O_2 \rightarrow MgO, \Delta H =$

What is the ΔH for the following reaction?

$3Mg + Fe_2O_3 \rightarrow 3MgO + 2Fe$

A. $-227.2kJ$

B. $-272.3kJ$

C. $227.2kJ$

D. $272.3kJ$

Answer: A

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37. Enthalpy of formation off HF and HCl are -161 kJ and -92 kJ, respectively.

Which of the following statements is incorrect?

A. HCl is more stable than HF

B. HF and HCl are exothermic compounds

C. The afinity of fluorine to hydrogen is greater than the affinity of chlorine to hydrogen

D. HF is jmore stable than HCl

Answer: D

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38. For the reaction, $2H_2 + O_2 \rightarrow 2H_2O, \Delta H = 571.$ bond energy of H-H=435, O=O=498, then calculate the average bond energy of O-H bond using the above data

A. 484

B. -484

C. 271

D. -271

Answer: A

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39. The bond energy of ann O-H bond is 109 kcal/mol. When 1 mole of water is formed, then

A. 1009 kcal is released

B. 218 kcal is absorbed

C. 109 kcal is absorbed

D. 218 kcal is released.

Answer: D

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40. Given the following thermochemical equations,

$$Zn + \frac{1}{2}O_2 \rightarrow ZnO + 84,000 \text{ cal}$$

$$Hg + \frac{1}{2}O_2 \rightarrow HgO + 21,700 \text{ cal}$$

Accordingly the heat of reaction for the following reaction, $Zn + HgO \rightarrow Hg +$ heat is

A. 105700 cal

B. 61000 cal

C. 10500 cal

D. 623000 cal

Answer: D

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41. The enthalpy of vaporisation of liquid water using the data

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H = -285.77kJ/mol$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g), \Delta H = -241.84kJ/mol$$

is

A. $+43.93kJ/mol$

B. $-43.93kJ/mol$

C. $527.61 kJ / mol$

D. $-527.61 kJ / mol$

Answer: A

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42. Energy requried to dissociate 4 g of gaseous hydrogen into free gaseous atoms is 208 kcal at $25^{\circ} C$. The bond energy of H-H will be

A. 104 kcal mol^{-1}

B. 52 kcal mol^{-1}

C. 10.4 kcal mol^{-1}

D. 1040 kcal mol^{-1}

Answer: A

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43. The enthalpy of a monoatomic gas at T kelvin is

A. $\frac{7}{2}RT$

B. $\frac{3}{2}RT$

C. $\frac{1}{2}RT$

D. $\frac{5}{2}RT$

Answer: D

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44. The enthalpy change (ΔH) for the process, $N_2H_4(g) \rightarrow 2N(g) + 4H(g)$ is

is 1724 kJ mol^{-1}. If the bond energy of N-H bond in ammonia is 391 kJ mol^{-1}, what is the bond energy for N-N bond in N_2H_4?

A. 391 kJ mol^{-1}

B. 160 kJ mol^{-1}

C. 1173 kJ mol^{-1}

D. 320 kJ mol^{-1}

Answer: B

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45. $CH_2 = CH_2(g) + H_2(g) \rightarrow CH_3 \rightarrow CH_3(g)$

The heat of reaction is [bond energy of C=C=80 kcal, C=C=145 kcal, C-H=98 kcal, H-H=103 kcal]

A. -14 kcal

B. -28 kcal

C. -42 kcal

D. -56 kcal

Answer: B

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46. The following is (are) endothermic reaction

I. combustion of methane.

II. Decomposition of water.

III. Dehydrogenation of ethane to ethylene

IV. Conversion of graphite to diamond

A. (I) and (II)

B. (II) and (III)

C. (III) and (IV)

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

Answer: D

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47. In a calorimeter, the temperature of the calorimeter increases by 6.12 K, the heat capacity of the systemm is 1.23 kJ/g/deg. What is the molar

heat of decomposition for the ammonium nitrate?

A. $-7.53kJ/mol$

B. $-398.1kJ/mol$

C. $-16.1kJ/mol$

D. $-602kJ/mol$

Answer: D

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48. Consider the following reaction and corresponding energy diagram:

$A \rightarrow P$

which of the following statements is incorrect?

A. It is a two step reaction

B. First step is slower than second step

C. A is more unstable compared to P

D. All steps are exothermic

Answer: D

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49. Heat of formation of H_2O is -188kJ/mol and H_2O_2 is -286 kJ/mol. The enthalpy change for the reaction,

$2H_2O_2 \rightarrow 2H_2O + O_2$

A. 196 kJ

B. $-196kJ$

C. $984kJ$

D. $-984kJ$

Answer: A

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50. ΔH for combustion of ethene and ethyne are -341.1 and -310.0 kcal, respectively. What will be the ratio of calorific values of ethane and ethyne, respectively?

A. $1:0.95$

B. $0.65:2$

C. $0.95:1$

D. $0.002:1$

Answer: C

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51. 2.1 g of Fe combines with S evolving 3.77 kJ. The heat of formation of FeS (in kJ/mol) is

A. -1.79

B. 100.5

C. -3.77

D. none of these

Answer: B

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52. The standard enthalpy of formation of NH_3 is $-46.0kJmol^{-1}$. If the enthalpy of formation of H_2 from its atoms is $-436kJmol^{-1}$, the average bond enthalpy of N-H bond in NH_3 is

A. $-964kJmol^{-1}$

B. $-352kJmol^{-1}$

C. $+1056kJmol^{-1}$

D. $-1102kJmol^{-1}$

Answer: B

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53. 

The above diagram represents

A. enthalpy for exothermic reactions

B. enthalpy for endothermic reactions

C. entropy for exothermic reaction

D. entropy for endothermic reaction

Answer: A

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54. Calculate the bond enthalpy of $Xe-F$ bond as given in the equation,

$XeF_4(g) \rightarrow Xe^+(g) + F^-(g) + F_2(g) + F_g, \Delta_r H = 292 \text{ kcal } mol^{-1}$

Ionisation energy of Xe=279 kcal/mol bond energy (F-F)=38 kcal/mol

Electron affinity of F=85 kcal/mol

A. 8.5 kcal/mol

B. 34 kcal/mol

C. 24 kcal/mol

D. none of these

Answer: B

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55. 18 g of water is taken to prepare, the tea. Find out the internal energy of vaporisation at $100^\circ C$. $\left(\Delta_{vap}H^\ominus \text{ for water at } 373K = 40.66kJmol^{-1}\right)$

A. 37.56 kJ mol^{-1}

B. -37.56 kJ mol^{-1}

C. 43.76 kJ mol^{-1}

D. -43.76 kJ mol^{-1}

Answer: A

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56. Which of the following statement is incorrect about the equation?

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l), \Delta_r H^- = -1367 \text{ kJ } mo$

A. the reaction is endothermic in nature.

B. The numerical value of $\Delta_r H^\ominus$ refers to the number of moles of substances specified by an equation. Standard enthalpy change $\Delta_r H^\ominus$ will have units as kJ mol^{-1}

C. The coefficients in a balanced thermochemical equations refer to the number of moles (never molecules) of reactants and products involved in the reaction

D. The equation describes the combustion of liquid ethanol at constant temperature and pressure.

Answer: A

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57. Calculate the enthalpy of vaporisation of I_2 if the sublimation energy and enthalpy of fusion of I_2 is 57.3 kJ mol^{-1} and 15.5 kJ mol^{-1} respectively

A. $-72.8 \text{ kJ } mol^{-1}$

B. $72.8 \text{ kJ } mol^{-1}$

C. $-41.8 \text{ kJ } mol^{-1}$

D. $+41.8 \text{ kJ } mol^{-1}$

Answer: D

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58. A system containing some quantity of water in a thermos flask or in an insulated beaker. This would not allow exchange of heat between the system and surrouding through its boundary. This process is called as

A. isothermal process

B. adiabatic process

C. isochoric process

D. isobaric process

Answer: B

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59. For the reaction $A \to B, \Delta H = +23kJ/mol$ and $B \to C, \Delta H = -18kJ/mol,$ the decreasing order of enthalpy of A,B,C follows the order

A. A,B,C

B. B,C,A

C. C,B,A

D. C,A,B

Answer: B

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60. The ratio of enthalpy of vaporisation and the normal boilng point of a liquid approximately equals to (i)____. The above statement follows the (ii)_____. Choose the correct word to complete the above statement.

A. (i) 88 J $mol^{-1}K^{-1}$, (ii) capacity rule

B. (i) 88 kJ $mol^{-1}K^{-1}$, (ii) Trouton's rule

C. (i) 88 kJ $mol^{-1}K^{-1}$, (ii) capacity rule

D. (i) 88 J $mol^{-1}K^{-1}$, (ii) Trouton's rule

Answer: D

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61. Arrange the following units in the decreasing order of their value

A. 1 cal gt 1 erg gt 1 eV gt 1 Joule

B. 1 cal gt 1 Joule gt 1 erg gt 1 eV

C. 1 cal gt 1 eV gt 1 erg gt 1 Joule

D. 1 Joule gt 1 eV gt 1 erg gt 1 cal

Answer: B

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62. The reaction of cyanamide, $NH_4CN(s)$, with dioxygen was carried out in a bomb calorimeter, and ΔU was found to be -742.7 kJ mol^{-1} at 298 K. calculate the enthalpy change for the reaction at 298 K.

$$NH_4CN(g) + \frac{3}{2}O_2(g) \rightarrow N_2(g) + CO_2(g) + H_2O(l)$$

A. $-741.46 \ \text{kJ} \ mol^{-1}$

B. $741.46 \ \text{kJ} \ mol^{-1}$

C. $241.46 \ \text{kJ} \ mol^{-1}$

D. $-241.6 \ \text{kJ} \ mol^{-1}$

Answer: A

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63. Consider the following reactions:

(i) $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightarrow NO(g), \Delta_r H^{\ominus} = 90 \ \text{kJ} \ mol^{-1}$

(ii) $NO(g) + \frac{1}{2}O_2(g) \rightarrow NO_2(g), \Delta_r H^{\ominus} = -74 \ \text{kJ} \ mol^{-1}$

Select the correct statement about the given reaction.

A. In (i) reaction, $NO(g)$ is unstable because the energy is released. The energy is released in (ii) reaction, $NO_2(g)$ is stable. Unstable NO(g) changes into the stable $NO_2(g)$

B. The energy is absorbed in (i) reaction, NO(g) is unstable. As energy is released in the (ii) reaction $NO_2(g)$ is stable. That's why unstable NO(g) changes into the stable $NO_2(g)$

C. Both (a) and (b)

D. none of these

Answer: B

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64. In view of the signs of $\Delta G^{\ominus}$ for the following reactions,

$PbO_2 + Pb \rightarrow 2PbO, \Delta_r G^{\ominus} < 0,$

$SnO_2 + Sn \rightarrow 2SnO, \Delta_r G^{\ominus} > 0$

Which oxidation states are more characteristic for lead and tin?

A. For lead +4, for tin +2

B. For lead +2, ffor tin +2

C. For lead +4, for tin +4

D. For lead +2, for tin +4

Answer: D

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65. In an irreversible process taking place at constant T and p and in which only pressure volumee work is being done, the change in Gibbs free energy (dG) and change in entropy (dS), satisfy the criteria.

A. $(dS)_{V,E} < 0, (dG)_{T,p} < 0$

B. $(dS)_{V,E} > 0, (dG)_{T,p} < 0$

C. $(dS)_{V,E} = 0, (dG)_{T,p} = 0$

D. $(dS)_{V,E} = 0, (dG)_{T,p} > 0$

Answer: B

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66. In adiabatic conditions 1 mole of CO_2 gas at 300 K is expanded such that its volume becomes 27 times. Calculate the work done.

($C_V = 6 \ \text{cal} \ \ mol^{-1}$ and $\gamma = 1.33$ is given)

A. 1400 cal

B. 1000 cal

C. 900 cal

D. 1200 cal

Answer: D

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67. $\Delta_f U^\ominus$ for the formation of $CH_4(g)$ at certain temperature is -393 kJ mol^{-1}. The value of $\Delta_f H^\ominus$ is

A. zero

B. $< \Delta_f U^\ominus$

C. $> \Delta_f U^{\ominus}$

D. equal to $\Delta_f U^{\ominus}$

Answer: B

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68. 1.0 mole of a monoatomic ideal gas is expanded from state (I) to state (II) as shown in the figure. Calculate the work done for the expansion of gas from state (I) to state (II) at 298K.

A. $-1771.46J$

B. $-1717.46J$

C. $+1771.46J$

D. $+1717.46J$

Answer: B

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69. What is the equilibrium constant, K for the following reaction at 400 K?

$2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$

$\Delta H = 77.2 \text{ kJ } mol^{-1}$ and $\Delta S = 122 JK^{-1} mol^{-1}$ at 400K.

A. -3.708

B. 1.95×10^{-4}

C. 2.8×10^{4}

D. 1.67×10^{-5}

Answer: B

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70. Match the columns with the laws of thermodynamics.

A. 1-A,2-C,3-A

B. 1-A,2-B,3-C

C. 1-C,2-B,3-A

D. 1-B,2-A,3-C

Answer: A

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71. Match the columns with the atomicity of gases to the heat capacity at constant pressure (C_p).

A. 1-B,2-C,3-A

B. 1-A,2-B,3-C

C. 1-C,2-A,3-B

D. 1-C,2-B,3-A

Answer: C

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72. An ideal gas is allowed to expand against a constant pressure of 2 bar from 10 L to 50 L in one step. The amount of work done by the gas is x. if the same expansion were carried out reversible, what is the relation of work done with the earlier case?

A. Lower

B. Higher

C. Same as before

D. Cannot anything

Answer: B

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73.

A sample of 1.0 mole of a monoatomic ideal gas is taken through a process of expansion and compression as shown in the figure. What will be the value of ΔH for the process as a whole?

A. -3.150

B. -2.303

C. $+2.303$

D. 0

Answer: D

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74. What would be the heat released when an aqueous solution containing 0.5 mole of HNO_3 is mixed with 0.3 mle of OH^-? (Enthalpy of neutralisation is -57.1 kJ)

A. 28.5 kJ

B. 17.1 kJ

C. 45.7 kJ

D. 1.7 kJ

Answer: B

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75. The molar heat capacity of water at constant pressure is 75 $JK^{-1}mol^{-1}$. When 1.0 kJ of heat is supplied to 100 g of water which is free to expand the increase in temperature of water is

A. 2.4 K

B. 3.6 K

C. 4. 8 K

D. 1.2 K

Answer: A

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76. For a reaction at $25^{\circ}C$, enthalpy and entropy changes are -11.7×10^{3} J mol^{-1} and -105 J $mol^{-1}K^{-1}$ respectively. What is the Gibb's free energy?

A. 15.05 kJ

B. 19.59 kJ

C. 2.55 kJ

D. 22.55 kJ

Answer: B

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77. The standard molar heat of formation ethane, CO_2 and water (l) are respectively -21.1, -94.1 and -68.3 kcal. The standard molar heat of combustion of ethane will be

A. $-372kcal$

B. 162 kcal

C. 240 kcal

D. 183.5 kcal

Answer: A

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78. The ΔH_f° of O_3, CO_3, NH_3 and HI are 142.2, -393.3, -46.2 and +25.9 kJ per mol, respectively. The order of their increasing stabilities will be

A. O_3, CO_2, NH_3, HI

B. CO_2, NH_3, HI, O_3

C. O_3, HI, NH_3, O_2

D. NH_3, HI, CO_2, O_3

Answer: C

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79. One molee of methanol when burnt in O_2, gives out 723 kJ mol^{-1} of heat. If one mole of O_2 is used, what will be the amount of heat evovled?

A. 723 kJ

B. 924 kJ

C. 482 kJ

D. 241 kJ

Answer: C

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80. ΔH_f° (298K) of methanol is given by the chemical equation,

A. $CH_4(g) + \frac{1}{2}O_2(g) \rightarrow CH_3OH(g)$

B. $C(\text{graphite}) + \frac{1}{2}O_2(g) + 2H_2(g) \rightarrow CH_3OH(l)$

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

D. $CO(g) + 2H_2(g) \rightarrow CH_3OH(l)$

Answer: B

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81. Formation of a solution from two components can be considered as

(1). pure solvent $\rightarrow$ separated solvennt molecules, ΔH_1

(2). Pure solute $\rightarrow$ separated solute molecules, ΔH_2

(3). Separated solvent and solute molecules $\rightarrow$ solution, ΔH_3

Solution so formed will be ideal if

A. $\Delta H_{\text{soln}} = \Delta H_1 - \Delta H_2 - \Delta H_3$

B. $\Delta H_{\text{soln}} = \Delta H_3 - \Delta H_1 - \Delta H_2$

C. $\Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 + \Delta H_3$

D. $\Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 + \Delta H - \Delta H_3$

Answer: C

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82. If the value of C_p for nitrogen gas is 7 $JK^{-1}mol^{-1}$, then the value of ΔH on heating 28 g of nitrogen gas from $0^\circ C$ to $100^\circ C$ at constant pressure will be

A. 1200 J

B. 700 J

C. 1400 J

D. 1500 J

Answer: B

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83. The equilibrium concentration o the species in the reaction $A + B \Leftrightarrow C + D$ are 3,5,10 and 15 mol L^{-1} respectively. At 300 K, the ΔG for the reaction is

A. 13.81

B. -1381.8

C. -138.18

D. 1391.6

Answer: B

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Mht Cet Corner

1. Identify an extensive property amongst the following:

A. Viscosity

B. Heat capacity

C. Density

D. Surface tension

Answer: B

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2. The criterion for a spontaneous process is

A. $\Delta G > 0$

B. $\Delta G < 0$

C. $\Delta G = 0$

D. $\Delta S_{\text{Total}} < 0$

Answer: B

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

A. $-2494J$

B. $-4988J$

C. $+4988J$

D. $+2494J$

Answer: D

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5. The pressure of a gas is 100 k Pa. if it is compressed from 1 m^3 to $10dm^3$, find the work done .

A. 99 kJ

B. $-99kJ$

C. $114.9kJ$

D. $-114.9kJ$

Answer: A

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6. Given, $R = 8.314 JK^{-1}mol^{-1}$), the work done during combustion of 0.090 kg of ethane (molar mass=30) at 300 K is

A. $-18.7kJ$

B. $18.7kJ$

C. $6.234kJ$

D. $-6.234kJ$

Answer: C

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7. 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: D

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8. The work done when two moles of an ideal gas is compressed from 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. $42495kJ$

Answer: A

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9. Assuming enthalpy of combustion of hydrogen at 273 K is -286 kJ 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. $+1622kJ$

B. $-1622kJ$

C. $+292kJ$

D. $-292kJ$

Answer: B

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10. Find the correct equation.

A. $E_2 - E_1 - H_2 + H_1 = n_2RT - n_1RT$

B. $E_2 - E_1 - H_2 - H_1 = n_2RT + n_1RT$

C. $H_2 - H_1 - E_2 + E_1 = n_2RT - n_1RT$

D. $H_2 - H_1 - E_2 + E_1 = n_2RT + n_1RT$

Answer: C

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11. The heat of neutralisation of a strong acid and a strong alkali is 57.0 kJ mol^{-1}. The heat releaed when 0.5 mole of HNO_3 solution is mixed with 0.20 mole of KOH solution is

A. 57.0 kJ

B. 11.4 kJ

C. 28.5 kJ

D. 34.9 kJ

Answer: B

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

A. initial condition of reactants

B. initial and final condition of reactants

C. intermediate path of the reaction

D. end conditions of reactats

Answer: B

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13. The heat of combustion of carbon is -393.5 kJ/mol. The heat released upon thee formation of 35.2 g off CO_2 from, carbon and oxygen gas is

A. $+315kJ$

B. $-31.5kJ$

C. $-315kJ$

D. $+31.5kJ$

Answer: C

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14. The heat of formation of water is 260 kJ. How much H_2O is decomposed by 130 kJ of heat?

A. 0.25 mol

B. 1 mol

C. 0.5 mol

D. 2 mol

Answer: C

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15. In_____process, work is done at the expense of internal energy.

A. Isothermal

B. isochoric

C. adiabatic

D. isobaric

Answer: C

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16. At the same conditions of pressure, volume and temperature, work done is maximum for which gas if all gases have equal masses?

A. NH_3

B. N_2

C. Cl_2

D. H_2S

Answer: A

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17. 16 g off oxygen gas expands isothermally and reversibly at 300 K from 10 dm^3 to 100 dm^3. The work done is (in J)

A. zero

B. $-2875J$

C. $+2875J$

D. infinite

Answer: B

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18. Heat of combusion of methane is -800 kJ. What is the heat of combustion of $4 \times 10^{-4} kg$ of methane?

A. $-800kJ$

B. $-3.2 \times 10^4 kJ$

C. $-20kJ$

D. $-1600kJ$

Answer: C

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19. Kirchhoff's equation is

A. $\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

B. $\log\frac{p_2}{p_1} = \frac{\Delta H_V}{2.303R}\left[\frac{T_2 - T_1}{T_1 \times T_2}\right]$

C. $\Delta C_p = \frac{\Delta H_2 - \Delta H_1}{T_2 - T_1}$

D. $\log\frac{k_2}{k_1} = \frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

Answer: C

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20. If ΔE is the heat of reaction for $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$ at constant volume, the ΔH (heat of reaction at constant pressure), at constant temperature is

A. $\Delta H = \Delta E + RT$

B. $\Delta H = \Delta E - RT$

C. $\Delta H = \Delta E - 2RT$

D. $\Delta H = \Delta E + 2RT$

Answer: B

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21. The bond energy is the energy required to

A. dissociate oneemole of the substance

B. dissociate bond in 1 kg of the substance

C. break onemole of similar bonds

D. break bonds in one mole of substance

Answer: C

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22. For the reaction

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g), \Delta H^{\ominus} = -573.2kJ$

The heat of decomposition of water per mole is

A. 286.6 kJ

B. 573.2 kJ

C. $-28.66kJ$

D. zero

Answer: A

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23. For an ideal gas, the heat of reaction at constant pressure and constant volumee are related as

A. $H + E = pV$

B. $E = H + p\Delta V$

C. $q_p = q_v + \Delta nRT$

D. none of these

Answer: C

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24. Hess's law is based on

A. law of conservation of mass

B. law of conservation of energy

C. first law of thermodynamics

D. none of these

Answer: B

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25. Which of the following is a path function?

A. Internal energy

B. Enthalpy

C. Work

D. Entropy

Answer: C

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26. In a closed containerr, a liquid is stirred with a paddle to increse the temperature. Which of the following is true?

A. $\Delta E = W \neq 0, q = 0$

B. $\Delta E = W = q \neq 0$

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

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

Answer: A

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27. The standard molar heat of formation of ethane, CO_2 and water (l) are -21.1, -94.1 and -68.3 kcal, respectively. The standard molar heat of combustion of ethane will be

A. $-373kcal$

B. $162kcal$

C. $-240kcal$

D. $183.5kcal$

Answer: A

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28. The CO_2 gas does not follow gaseous laws at all ranges of pressure and temperature because

A. it is triatomic gas

B. its internal energy is quite high

C. there is attraction between its molecules

D. it solidity at low temperature

Answer: C

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29. Heat of neutralisation will be minimum for which of the following combination?

A. $NaOH + H_2SO_4$

B. $NH_4OH + CH_3COOH$

C. $NaOH + HCl$

D. $NaOH + CH_3COOH$

Answer: B

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30. 2 moles of helium gas expanded isothermally and irreversibly at $27^\circ C$ from volume 1 dm^3 to 1 m^3 at constant pressure of 100 kPa. Calculate the work done.

A. 99900 kJ

B. 99900 J

C. 34464.65 kJ

D. 34464.65 J

Answer: B

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31. Heat of formation of SO_2 is -298 kJ. What is the heat of combustion of 4 g of S?

A. $+37kJ$

B. $-37.25kJ$

C. $+298kJ$

D. $18.6kJ$

Answer: B

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32. Bond energy of hydrogen gas is -433 kJ. How much is the bond dissociation energy of 0.5 mole of hydrogen gas?

A. $-433kJ$

B. $+433kJ$

C. $-216kJ$

D. $+216kJ$

Answer: D

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

A. $\Delta H = \Delta E$

B. $\Delta H > \Delta E$

C. $\Delta H < \Delta E$

D. none of these

Answer: B

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34. Enthalpy (H) is equal to

A. internal energy (E)

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

C. internal energy (E)+pV

D. work (W) done by a system

Answer: C

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35. If the heat formation of CO_2 is -393kJ. The amount of heat evolved in the formation of 0.176 kg of CO_2 is

A. $-1357.9kJ$

B. $-1275.9kJ$

C. $-1572.0kJ$

D. $-1165.5kJ$

Answer: C

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36. If a gas, at constant temperature and pressure expands, then its

A. entropy first increases and then decreases

B. internal energy increases

C. internal energy remains the same

D. internal energy decreases

Answer: C

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37. Molar heat capacity at constant volume can be given a

A. $C_V = \frac{dE}{dT}$

B. $C_V = \frac{dH}{dT}$

C. $C_p = \frac{dE}{dT}$

D. $C_p = \frac{dH}{dT}$

Answer: A

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38. Mass and energy are conserved is demonstrated by

A. first law of thermodynamics

B. law of conservation of energy

C. law of conservation of mass

D. modified form of Ist law of thermodynamics

Answer: A

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39. If ΔG° for the reaction given below is 1.7 kJ, the equilibrium constant of the reaction,

$2HI(g) \Leftrightarrow H_2(g) + I_2(g)$ at $25^{\circ}C$, is

A. 0.5

B. 2

C. 3.9

D. 24

Answer: A

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40. It is general principle that the less energy a system constains, it is

A. less stable

B. more stable

C. unstable

D. more unstable

Answer: B

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