



CHEMISTRY

BOOKS - A2Z CHEMISTRY (HINGLISH)

CHEMICAL THERMODYNAMICS

Basic Terms Of Thermodynamic Processes

1. In thermodynamics, a process is called reversible when

A. surrounding is no boundary between syatem and surrounding

B. there is no boundary between system and surrounings

C. the surrounding are always in equilibrium with the

system

D. the system change into the surroundings spontaneous

Answer: C



2. Calculate the work done during the process, when one mole of gas is allowed to expand freely into vacuum.

A. 0

B. + ve

C. -ve

D. any of there

Answer: A

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3. The work done in erge for the reversible expansion of 1 mole of an ideal gas from a volume of 10 litres to 20 litres at $25^{\circ}C$ is

A. $-2.303 imes298 imes0.082\log 2$

 $\texttt{B.}-298\times10^7\times8.31\times2.3031\log2$

C. $2.303 imes 298 imes 0.082 \log 0.5$

D. $-8.31 imes10^7 imes298 imes2.303\log 0.5$

Answer: B

4. 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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5. Which one is not a state function ?

A. Internal energy (E)

B. Volume

C. Heat (q)

D. Enthalpy

Answer: C



6. When no heat energy is allowed to enter or leave the system, it is called

A. Isothermal proecess

B. Reversible process

C. Adiabatic process

D. Irreversible process

Answer: C Vatch Video Solution

7. Which of the following is the intensive property?

A. Temperature

B. Viscosity

C. Density

D. All of these

Answer: D

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8. For the following process, $H_2(g) o 2H(g)$. It absorbs $438kJmol^{-1}$. Thus,

A. change in internal energy of the system is $219 K J mol^{-1}$

B. internal energy of the system is $438 K Jmol^{-1}$

C. change in internal energy if $438KJmol^{-1}$

D. internal energy of the system is $219KJmol^{-1}$

Answer: C



9. A system is changed from state A to state B by one path and from B to A by another path. If ΔE_1 and ΔE_2 are the corresponding changes in internal energy, then

A.
$$\Delta E_2 + E_2 = + ve$$

B.
$$\Delta E_1 + \Delta E_2 = -ve$$

C. $\Delta E_1 + \Delta E_2 = 0$

D. none of these

Answer: C



10. Which one of the following statement is false?

A. work is a state function

B. temperature is a state function

C. change in the state is completely defined when the

intial and final state are specified

D. work appears at the boundary of the systam

Answer: C



11. Which of the following is the intensive property?

A. boiling point

B. molarity

C. freezing point

D. all of these

Answer: D

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12. Warming ammonium chloride with sodium hydroxide in a

test tube is an example of :

A. Closed system

B. Isolated system

C. Open system

D. None of these

Answer: C

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13. A well stoppered thermo flask containing some ice cubse

is an example of

A. Closed system

B. Open system

C. Isolated system

D. None of these

Answer: C



14. In which process net work done is zero?

A. Cyclic

B. Isochoric

C. Free expansion

D. Adiabatic

Answer: C



15. For the real gases reaction $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$: $\Delta H = -560kJ$. In a 10 litre rigid vesel at 500K, the initial pressure is 70 bar and after the reaction it becomes 40 bar. The change in internal energy is:

 $\mathsf{A.}-557KJ$

 $\mathsf{B.}-530KJ$

 ${\rm C.}-563KJ$

D. none of these

Answer: C

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16. For the reaction,

 $C+O_2
ightarrow CO_2, \Delta H=~-~393J$

 $2Zn+O_2
ightarrow 2ZnO, H=~-412J$

A. Carbon reduce ZnO to Zn

B. Oxidation of carbon is not feasible

C. Oxidation of Zn is not feasible

D. Zn liberates more heat than carbon during oxidation



17. A system absorbs 600J of heat and work equivalent to 300J on its surroundings. The change in internal energy is:

A. 300J

 $\mathsf{B.}\,400J$

 $\mathsf{C.}\,500J$

 $\mathsf{D.}\,600J$

Answer: D

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18. The density of ice at $0^{\circ}C$ is 0.99987g/cc. The work done for melting mole of ice at 1.00 bar (assuming work is done only due to expansion) is approximately

A. 0.17J

B. $1.7 imes 10^3 J$

C. $1.7 imes 10^{-6}J$

D. can't be determined

Answer: A



19. 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. 900KJ

 $\mathrm{B.}-900J$

 $\mathsf{C.}\ 270KJ$

 $\mathrm{D.}-900J$

Answer: B

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20. The difference between ΔH and ΔE (on a molar basis)

for the combustion of n-octane (l) at $25^{\,\circ}C$ would be:

A. -13.6KJ

 $\mathsf{B}.\,1.14KJ$

 $\mathsf{C}.-11.15KJ$

$\mathsf{D.}+11.15KJ$

Answer: D



21. For the combustion reaaction at 298K $H_2(g) + 1/2O_2(g)
ightarrow H_2O(l)$

•

Which of the following alternetive (s) is/are correct ?

- A. $\Delta H = \Delta E$
- B. $\Delta H > \Delta E$

 ${\rm C.}\,\Delta H < \Delta E$

D. $\Delta H \& \Delta E$ have no relation with each other

Answer: C



22. Consider the reaction: $N_2 + 3H_2 \Leftrightarrow 2NH_3$ carried out at constant pressure and temperature. If ΔH and ΔU are change in enthalpy and change in internal energy respectively, then:

- A. $\Delta H=0$ B. $\Delta H=\Delta U$ C. $\Delta H<\Delta U$
- D. $\Delta H > \Delta U$

Answer: C

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

 $\mathsf{A.}-7.43$

B. 3.72

C. - 3.72

 $D.\,7.43$

Answer: A



24. Find the work done when 2 moles of hydrogen expand isothermally from 15 to 50 litres against a constant pressure of 1atm at $25^{\circ}C$.

A.~847.0 cal

 $\mathsf{B.}\,847K cal$

 ${\sf C.\,84.7} cal$

 $\mathsf{D.}\,84.7K cal$

Answer: A



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

$$ig(R=8.314K^{\,-1}mol^{\,-1}ig)$$

A. $2477.57 mol^{-1}$

B. -1238.78*Jmol*⁻¹

C. 1238.78*Jmol*⁻¹

D. $-2477.57 Jmol^{-1}$

Answer: A



26. Calculate the work done when 2 moles of hydrogen expand isothermally and reversibly at $27^{\circ}C$ from 15 to 50 litres.

A. 14.45Kcal

 $\mathsf{B}.\,1445J$

 $\mathsf{C.}-1445 cal$

D. 14.45KJ

Answer: C



27. An ideal gas expands from an initial volume V into vacuume under isothermal conditions. For this process,

A.
$$\Delta U
eq 0, W = 0$$
 and $Q
eq 0$

B.
$$\Delta U
eq 0, W
eq 0$$
 and $Q
eq O$

C. $\Delta U
eq 0, W
eq 0$ and Q = 0

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

Answer: D

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

A. (a) T_f and T_i are both reversible and irreversible processes

$$\mathsf{B.}\left(T_{f}\right)_{irrev} > \left(T_{i}\right)_{rev}$$

C. $T_f > T_i$ for irreversible process but T_f and T_i for

irreversible process

D. $\left(T_f\right)_{rev} > \left(T_i\right)_{irrev}$

Answer: D

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29. Calculate the work invoved when when 1 mol of an ideal gas is compressed reversibly from 1.00 bar to 5.00 at a constant temperature of 300K.

 $\mathsf{A.}-14.01KJ$

 $\mathsf{B.}+18.02KJ$

 $\mathsf{C.}\,4.01KJ$

 $\mathrm{D.}-8.02KJ$

Answer: C



30. A gas expands isothermally and reversibly. The work done

by the gas is

A. Zero

B. Minimum

C. Maximum

D. can't be determined

Answer: C



31. Evaluate ΔU at 500K for the process

 $Mg(s)+2HC1(g)=MgC1_2(s)+H_2(g)$

 $\Delta H = -109 K cal$

The volume change of solids to be ignored

 ${\rm A.}-204 K cal$

 ${\rm B.}-108 K cal$

C. - 9Kcal

D. + 9Kcal

Answer: C



32. A piston filled with 0.04 mol of an ideal gas expands reversibly from 50.0mL to 375mL at a constant temperature of $37.0^{\circ}C$. As it does so, it absorbs 208J of heat. The value of

q and w for the process will be:

$$(R=8.314 J/mol K)(\ln 7.5=2.01)$$

A.
$$q=\,+\,208J, W=\,-\,208J$$

B.
$$q = -208J, W = -208J$$

C.
$$q=~-~208J, W=~+~208J$$

D.
$$q = +208J, W = +208J$$

Answer: B

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33. If 50 calories are added to a system and system does work

of $30\ {\rm calories}$ on surroundings, the change in internal energy

of system is

A. 20*cal*

 $\mathsf{B.}\,50 cal$

 $\mathsf{C.}\,40 cal$

D. 30 cal

Answer: A

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34. When heat is supplied to an ideal gas in isothermal process, the

A. Gas will do positive work

B. Gas will do negitive work

C. Knetic energy of the gas will incease

D. Gas will not obey the law of conservation of energy

Answer: A

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35. 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 $-1366.5KJmol^{-1}$. The value of internal energy change for the above reaction at this tempearature will be

 $\mathsf{A.}-1371.5KJ$

 $\mathsf{B.}-1369.0KJ$

 ${\rm C.}-1364.0KJ$

 $\mathsf{D.}-1361.5KJ$

Answer: C

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36. When a polyatomic gas undergoes an adiabatic process, its temperature and volume are related by the equation TV^n =constant, the value of n will be

A. 1.33B. 0.33C. 2.33

D. 1

Answer: B



37. For the reation $F_2(g)+2HCL(g) o 2HF(g)+C1_2(g)$ ΔH° at 298K is -84.4Lcal $\Delta H^\circ f(HF)=-64.2Kcal/mol$ $\Delta H^\circ f$ for the HCL(g) per gram is

,

 ${\rm A.}-0.603 K cal$

 $\mathbf{B.}-0603 cal$

 ${\rm C.}\, 0.0603 K cal$

 $\mathsf{D.}\, 6.03 K cal$

Answer: A



38. The coefficient of thermal expansion, α , is nearly constant for a liquid $\alpha = \frac{1}{V} \left(\frac{dV}{dT} \right)_P$ At 293K and 1*atm* for water $\alpha = 2.1K^{-1}$

What is the approximate work done when 1 mole of liquid is heated from 288K at 1 atm? Molar volume of liquid = 18m?

 $\mathsf{A.}-78.25KJ$

 $\mathsf{B.}\,78.15J$

 ${\rm C.}-37.8J$

 $\mathsf{D.}-83.14J$

Answer: C



39. A stationary mass of gas is compressed without friction from an initial state of $0.3m^2$ and 0.105M pa to a final state of $0.15m^3$ and 0.15M pa. The pressure remaining constant. During the process there is a transfer of 37.6KJ of heat from the system. During the process the amount of internal energy change is

 $\mathsf{A.}-28.85KJ$

 $\mathrm{B.}-21.85KJ$

 ${\rm C.}-21.85 MJ$

 $\mathrm{D.}-15750KJ$

Answer: B

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40. For an adiabatic reversible expansion of a perfect gas $\Delta P/P$ is equal to

A.
$$\frac{\Delta V}{V}$$

B. $\gamma \frac{\Delta V}{V}$
C. $-\gamma \frac{\Delta V}{V}$
D. $-\gamma^2 \frac{\Delta V}{V}$

Answer: C

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41. Heat of combustion of ethanol at constant pressue and at temperature TK(=298K) is found to be $-qJmal^{-1}$.

Hence, heat of combustion (in $Jmol^{-1}$) of ethanol at the same temperature at constant volume will be:

A. RT-qB. -(q+RT)C. q-RTD. q+RT

Answer: C

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42. For the combustion of n-octane

 $C_8 H_{18} + O_2
ightarrow CO_2 + H_2 O$ at $25^\circ C$ (ingnoring resonance in CO_2)

A. $\Delta H = \Delta E - 5.5 imes 8.31 imes 0.298$ in KJ/mol

B. $\Delta H = \Delta E + 4.5 imes 8.31 imes 0.298$ in KJ/mol

C. $\Delta H = \Delta E - 4.5 imes 8.31 imes 0.298$ in KJ/mol

D. $\Delta H = \Delta E - 4.5 + 8.31 imes 0.298$ in KJ/mol

Answer: A

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43. Adiabatic reversible expansion of a gas is represented by

A.
$$\left(\frac{T_1}{T_2}\right)^{\gamma} = \left(\frac{P_2}{P_1}\right)^{1-\gamma}$$

B. $\left(\frac{T_1}{T_2}\right)^{\gamma} = \left(\frac{P_1}{P_2}\right)^{1-\gamma}$
C. $\left(\frac{T_1}{T_2}\right)^{\gamma} = \left(\frac{P_1}{P_2}\right)^{\gamma-1}$

D. All of the above
Answer: C

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44. When a gas is subjected to adiabatic expansion, it gets cooled due to

A. Loss in heat

B. Increases in internal energy

C. Due to repulsion between molecule

D. Energy spent in doing work

Answer: D

45. One mole of an ideal gas at 300K is expanded isothermally from an inital volume of 1 letre to 10 litres. The ΔE for this process is $\left(R = 2calmol^{-1}K^{-1}\right)$

A. 163.7*cal*

B. zero

 $\mathsf{C.}\,138.1 cal$

 ${\rm D.}\,9L\,{\rm atm}$

Answer: D



46. One mole of a non-ideal gas undergoes a change of state

(2.0atm, 3.0L, 95K)
ightarrow (4.0atm, 5.0L, 245K)

With a change in internal energy $\Delta E=30L$ atm. The change in enthalpy (ΔH) in the process in *L*-atm is

A. 40.0

B.42.3

C.44.0

D. Not defined, because pressure is not cosntant

Answer: C



47. Heat of formation of $H_2O(g)$ at 1 atm and $25^\circ C$ is

-243KJ . ΔE for the reaction $H_2(g)+30JK^{-1}mol^{-1}rac{1}{2}$ $O(g) o H_2O(g)$ at $25^\circ C$ is

A. 241.8KJ

 $\mathsf{B.}-241.8KJ$

 ${\rm C.}-243KJ$

D. 243KJ

Answer: C

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48. A gas absobs 100J of heat and is simultaneously compressed by a constant external pressure of 1.50 atmosphere fron a volume of 8L to $2L \cdot \Delta E$ will be

 $\mathsf{A.}-812J$

 $\mathsf{B}.\,812$

 $\mathsf{C}.\ 1011J$

 $\mathsf{D}.\,911J$

Answer: B

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49. A gas expands againts a constant external pressure of 2.00 atm, increasing its volume by 3.40L. Simultaneously, the system absorbs 400J of heat from its surroungs. What is ΔE , in joules, for this gas?

A. - 689

B. - 289

C. + 400

D. + 289

Answer: C



50. Which of the following statement is wrong?

A. The two sulphur atoms in the thiosoulphate ions

occoupy equivalent positions

B. Ice results from cooling of water whereas snow results

from cooling of vapour to solid

C. Formation of ice is solidification whereas formation of

snow is hoar frost

D. Ice sublimes on moon

Answer: B

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Work, Internal Energy And Enthalpy

1. The relation between the volume and temperature of a sample of water in the range $0^{\circ}C$ to $100^{\circ}C$ is best represented as





Answer: A



2. One gram-atom of graohite and one gram-atom of diamond were separately burnt to CO_2 . The amount of heat liberated was 393.5KJ and 305.4KJ respectivaly. It is apparent that

A. graphite has grreater affinity for oxygen

B. diamond has grreater affinity for oxygen

C. graphite is more stable than diamond

D. diamond is more stable than graphite

Answer: D



3. For the raction

 $B_2H_6(g)+3O_2(g) o B_2O_2(s)+3H_2O(l)$

 $\Delta E = -2143.2KJ$

Calculate ΔH for the reaction at $25^{\,\circ}C$

A. $-2148.2 K Jmol^{-1}$

B. $-2138.6 K Jmol^{-1}$

 $C. - 2133.2 K Jmol^{-1}$

D. $-2143.2 K Jmol^{-1}$

Answer: C

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4. For the reaction,

 $X_2O_4(l)
ightarrow 2XO_2(g), \Delta E=2.1 K cal$,

 $\Delta S = 20 cal \, / \, K$ at 300 K . Hence ΔG is

 ${\rm A.}\ 2.7 K cal$

 ${\rm B.}-2.7 K cal$

 ${\rm C.}\,9.3K cal$

D.-9.3Kcal

Answer: A

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5. Combustion of methance

A. is an exothermic reaction

B. is an endothermic reaction

C. requires a catalyst

D. given H_2

Answer: B

6. 10mol of an ideal gas confined to a volume of 10L is released into atmosphere at 300K where the pressure is 1bar. The work done by the gas is $(R = 0.083LbarK^{-1}mol^{-1})$

A. 2490L-bar

B. 259L-bar

C. 239L-bar

D. 220L-bar

Answer: A



7. $NH_3(g) + 3C1_2(g) o NCL_3(g) + 3HC1(g)\Delta H_1$ $N_2(g) + 3H_2(g) o 2NH_3, \Delta H_2$ $H_2(g) + CL_2(g) o 2HC1(g), \Delta H_1$ The heat of fomation of $NC1_2(g)$ in the terms of ΔH_1 , ΔH_2 and ΔH_3 is

A.
$$\Delta H_f = -\Delta H_1 + rac{\Delta H_2}{2} - rac{3}{2}\Delta H_3$$

B. $\Delta H_f = \Delta H_1 + rac{\Delta H_2}{2} - rac{3}{2}\Delta H_3$
C. $\Delta H_f = \Delta H_1 - rac{\Delta H_2}{2} - rac{3}{2}\Delta H_3$

D. None of the above

Answer: B

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

A. The nature of intermediate state

B. The difference in initial and final temperature

C. The physical state of reactant and product

D. Use of different reactant for the same reaction

Answer: A



9. Enthalpy of combustion of CH_4 , C_2H_6 and C_3H_8 are -210-370 and -530Kcal/mol respectivaly. The approximate value of enthalpy of combustion of *n*-hexane is

$$\begin{array}{l} \text{A.} -1170 \frac{Kcal}{mol} \\ \text{B.} -750 \frac{Kcal}{mol} \\ \text{C.} -1010 \frac{Kcal}{mol} \\ \text{D.} -590 \frac{Kcal}{mol} \end{array}$$

Answer: C

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10. Given, $H_2(2)+Br_2(g) o 2HBr(g)$, Δh_1° and standerd enthalpy of condensation of bromine is ΔH_2° , standard enthalpy of formation of HBr at $25^\circ C$ is

A. $\Delta H_1^{\,\circ}\,/\,2$

B. $\Delta H_1^{\,\circ}\,/\,2+\Delta H^{\,\circ}\,2$

C. $\Delta H_1^{\,\circ} - \Delta H_2^{\,\circ} \,/ \, 2$ s

D.
$$\left(\Delta H_1^{\,\circ} - \Delta H_2^{\,\circ}
ight)/2$$

Answer: D

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

A. 1.13KJ

B. 18.69*KJ*

 $\mathsf{C.}+18.69KJ$

$\mathsf{D.}+1.13KJ$

Answer: D



12. The enthalpies of combustion of carbon and carbon monoxide are -393.5 and $-282.5 K Jmol^{-1}$ respectivaly. The enthalpy of formation of carbon monoxide per mole is:

 $\mathsf{A.}-110.5KJ$

 $\mathsf{B.}\,676.5KJ$

 ${\rm C.}-67h6.5KJ$

 $\mathsf{D}.\,110.5KJ\mathsf{s}$

Answer: A

13. The heat of formation of $C_2H_5OH(l)$ is -66Kcal/mol . The heat of combustion of $CH_3OCH_3(g)$ is -348Kcal/mol

, ΔH_f for H_2O and CO_2 are -68Kcal/mol and -94Kcal/mol. Respectively. Then, the ΔH for the isomerisation reaction $C_2H_5OH(l) \rightarrow CH_3OCH_3(g)$, and ΔE for the same are at $T=25^\circ C$

A. $\Delta H = 18 K cal \, / \, mol, \, \Delta E = 17.301 K cal \, / \, mol$

B. $\Delta H = 22 K cal \, / \, mol, \, \Delta E = 21.408 K cal \, / \, mol$

C. $\Delta H = 26 K cal \, / \, mol, \, \Delta E = 25.709 K cal \, / \, mol$

D. $\Delta H = 30 K cal \, / \, mol, \, \Delta E = 25.709 K cal \, / \, mol$

Answer: A



14. 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. $\frac{2x-y}{2}$ B. $\frac{y-2x}{2}$ C. 2x-yD. y=2x

Answer: B

15. Assuming that water vapour is an ideal gas, the internal energy change (ΔU) when 1 mole of water is vaporised at 1 bar pressure and $100^{\circ}C$, (given: molar enthalpy of vaporisation of water $-41KJmol^{-1}$ at 1 bar and 373K and $R = 8.3Jmol^{-1}Kmol^{-1}$) will be:

A. $4.100 K J mol^{-1}$

B. 3.7904*KJmol*⁻¹

C. 37.904*KJmol*⁻¹

D. 41.00*KJmol*⁻¹

Answer: C

16. Given that $C+2S
ightarrow CS_2\Delta H^\circ f=~+~117.0KJmol^{-1}$ (1)

 $C+O_2
ightarrow CO_2 \Delta H^{\,\circ} \, f=~-393.0 KJmol^{\,-1}$ (2)

 $S+O_2
ightarrow SO_2 \Delta H^{\,\circ} \, f= \ +\ 297.0 KJmol^{-1}$ (3)

The heat of combustion of $CS_2+3O_2
ightarrow CO_2+2SO_2$ is

A. $-807 K Jmol^{-1}$

B. $-1104 K J mol^{-1}$

C. $807 K J mol^{-1}$

D. 1104*KJmol*⁻¹

Answer: B

17. The enthaply at 298K of the reaction

 $H_2O_2(l) o + rac{1}{2}O_2(g)$ is $-23.5Kcalmol^{-1}$ and the enthaply of formation of $H_2O_2(l)$ is $-44.8Kcalmol^{-1}$. The enthaply of formatiom of $H_2O(l)$ is

A. $-68.3K calmol^{-1}$

B. $68.3K calmol^{-1}$

 $C. - 91.8 K calmol^{-1}$

D. 91.8*K*calmol⁻¹

Answer: A

18. Equal volumes of molar hydrochloric acid and subphuric acid are neutralized by dil. NaOH solution and x Kcal and y Kcal of heat are liberated respectively. Which of the following is true?

A. x = y

B.
$$x=rac{1}{2}y$$

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

D. None of these

Answer: A



19. From the standard enthalpies of formation values for some compounds (in $KJmol^{-1}$), predict which one of them will be most stable?

A. Propane
$$(g) \left(\Delta H_f^\circ = -103.8 \right)$$

B. *n*-Butane $(g) \left(\Delta H_f^\circ = -124.7 \right)$
C. *n*-Butane $(g) \left(\Delta H_f^\circ = -167.2 \right)$
D. *n*-Octane $(g) \left(\Delta H_f^\circ = -208.4 \right)$

Answer: D



20. ΔH_1° for $CO_2(g)$, CO(g) and $H_2O(g)$ are -393.5, -110.5 and $-241.8kJmol^{-1}$ respectively.

Standard enthalpy change for the reacion

 $CO_2(g)+H_2(g)
ightarrow CO(g)+H_2O(g)$ is

A. $524.1 K Jmol^{-1}$

B. $41.2 K J mol^{-1}$

 $C. - 262.5 K Jmol^{-1}$

 $D. - 41.2 K Jmol^{-1}$

Answer: B

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21. Which of the following statements is correct about heat

of combuustion?

A. It may be exothermic in some cases and endothermic in

other cases

B. It is applicable to gaseous substances only

C. It is always an exothermic reaction

D. Its value does not change with tempareture

Answer: B

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22. Given

 $N_2(g) + 3H_2(g) = 2NH_3(g), \Delta H^{\,\circ} = -\,22kcal.$ The

standard enthapy of formation of NH_3 gas is

A. -11Kcal/mol

B. 11Kcal/mol

 $\mathsf{C.}-22 K cal\,/\,mol$

D. 22Kcal/mol

Answer: A



23. Smelting of iron ore takes place through this reaction $2FeO_3(s)+3C(s) o 4Fe(s)+3CO_2(g)$ $\Delta H^\circ_-(f)$ of Fe_2O_3 and CO_2 are $-8242kJmol^{-1}$ and $-393.7kJmol^{-1}$

The reaction is

A. Endothermic

B. Exothermic

 $\mathsf{C.}\,\Delta H=0$

D. None of these

Answer: A



24. Consider the reaction,

 $4NO_2(g) + O_2(g) o 2N_2O_5(g), \Delta_r H = -111 kJ.$ If

 $N_2O_5(s)$ is formed instead of $N_2O_5(g)$ in the above reaction,

the $\Delta_r H$ value will be

(Given, ΔH of sublimation for N_2O_5 is $54kJmol^{-1}$)

 $\mathsf{A.}-165KJ$

 $\mathsf{B.}+54KJ$

 ${\rm C.}+219KJ$

 $\mathrm{D.}-219KJ$

Answer: A



25. (1) For the given heat of reaciton,

(i) $C(s) + O_2(g) = CO_2(g) + 97kcal$

(ii) $CO_2(g) + C(s) = 2CO(g) - 39kcal$

the heat of combustion of CO(g) is:

A. 68Kcal

B.-68Kcal

 $\mathsf{C.}+48K cal$

D. None

Answer: A

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26. Given the reaction at $967^{\circ}C$ and 1atm.

 $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$

 $\Delta H = 176 k J mol^{-1}$, then ΔE equals

A. 156.6KJ

 $\mathsf{B}.\,165.6KJ$

 $\mathsf{C}.\,16.6KJ$

 $\mathsf{D}.\,1.656KJ$

Answer: A

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27. 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. 21.16KJ

 $\mathrm{B.}-21.00KJ$

 ${\rm C.}-13.62KJ$

D. 13.6*KJ*

Answer: B

28. On the basis of the following thermochemical data :

$$\left(\Delta_f G^\circ H^+_{(aq.)} = 0\right)$$

 $H_2O_{(l)} \rightarrow H^+_{(aq.)} + OH^-_{(aq.)}, \Delta H = 57.32kJ$
 $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}, \Delta H = -286.20kJ$

The value of enthalpy of formation of $OH^{\,-}\,$ ion at $25^{\,\circ}\,C$ is $\,:\,$

A. -22.88KJB. -22.88KJC. +228.88KJD. -343.52KJ

Answer: B



29. Given that

 $egin{aligned} &3C(s)+2Fe_2O_3(s)
ightarrow 4Fe(s)+3CO_2(g),\ &\Delta H^\circ\,=\,-\,93657kcal ext{ at }25^\circ C\ &3C(s)+3O_2(g)
ightarrow 3CO_2(g),\ &\Delta H^\circ\,=\,-\,94050kcal ext{ at }25^\circ C\ \end{aligned}$ The value of $\Delta H^\circ\,_-(f)(Fe_2O_3)$ is

 $\textbf{A.}\ 16.750 K cal$

 $\mathsf{B.}-16.750 K cal$

 ${\rm C.}-196.5 K cal$

 $\mathsf{D.}-393K cal$

Answer: C

30. For which of the following equations is the enthapy change at $25^{\circ}C$ and 1 atm equal to $\Delta H_{f}^{\circ}(CH_{3}OH, l)$

A.
$$CO(g) + 2H_2(g)
ightarrow CH_2OH(l)$$

B. $CO(g) + 4H(g) + O(g)
ightarrow CH_3OH(l)$
C. $CO(g) + 4H(g) + O(g)
ightarrow CH_3OH(l)$
D. C (graphite) $+ 2H_2(g) + rac{1}{2}O_2(g)
ightarrow CH_3OH(l)$

Answer: C

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31. For an endothermic reaction,

A.
$$H_R=H_P$$

 $\mathsf{B}.\,H_R > H_P$

 $\mathsf{C}.\,H_R < H_P$

D. None

Answer: C

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32. 4.8*g* of *C* (diamond) on complete combustion evolves 1584*kJ* of heat. The standard heat of formation of gaseous carbon is 725kJ/mol. The energy required for the process C(graphite) \rightarrow C(gas) C(diamond) \rightarrow C(gas) are

A. 725, 727

B. 727, 725

C.725,723

D. none of these

Answer: C

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33. In the reaction

 $CO_2(g)+H_2(g)
ightarrow CO(g)+H_2O(g),$

 $\Delta H = 2.8 kJ$

ΔH represents

A. Heat of reaction

B. Heat of combustion

C. Heat of formation
D. Heat of solution

Answer: C



34. For the reaction

A(g)+2B(g)
ightarrow 2C(g)+3D(g) ,

the value of ΔH at $27^{\circ}C$ is 19.0kcal. The value of ΔE for

the reaction would be

$$\left(R=2.0 cal H^{-1} mol^{-1}
ight)$$

A. 20.8 K cal

 $\mathsf{B.}\,19.8K cal$

 $\mathsf{C.}\,18.8K cal$

 $\mathsf{D.}\,17.8K cal$

Answer: A



 $\mathrm{B.}\,\Delta E-2RT$

 $\mathrm{C.}\,\Delta E+RT$

D. $\Delta E - RT$

Answer: D

36. If $C(s) + O_2(g) o CO_2(g), \Delta H = X$ and

 $CO(g)+1/2O_2(g)
ightarrow CO_2(g), \Delta H=Y$, then the heat of

formation of CO is

- A. X + Y
- $\mathsf{B.}\,X-Y$
- $\mathsf{C}.\,Y-X$
- $\mathsf{D.}\, XY$

Answer: B



37. Heat of solution of $BaCl_2.2H_2O = 200kJmol^{-1}$

Heat of hydration of $BaCl_2 = -150 k Jmol^{-1}$

Hence heat of solution of $BaCl_2$ is

A. $350 K J mol^{-1}$

B. $50 K J mol^{-1}$

C. $-350 K Jmol^{-1}$

D. none of these

Answer: B



38. The mutual heat of neutralisation of 40gNaOH and

 $60CH_3COOH$ will be

A. 57.1KJ

B. less than 57.1KJ

C. more than 57.1Kj

D. 13.7KJ

Answer: B



39. ΔH_{comb}° of carbon is $-xkJmol^{-1}$. The standard formation of enthalpy of $CO_2(g)$ will be

A.
$$-xKJmol^{-1}$$

 $B. + xKJmol^{-1}$

C. $-x/3KJmol^{-1}$

D. Data is insufficient to predict it

Answer: A

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40. The heat of combustion of carbon is 394kJ. The heat evolved in combustion of $6.023 imes 10^{22}$ atoms of carbon is

A. 3940KJ

 $\mathsf{B.}\,394.0KJ$

 $\mathsf{C.}\,39.4KJ$

D.0.394KJ

Answer: A



41. Heat of neutralisation of a strong acid by a strong base is equal to ΔH of

A. $H^{+} + OH^{-} = H_2O$

B. $H_2O + H^+ = H_3O^+$

 $\mathsf{C.}\, 2H_2O_2=2H_2O$

 $\mathsf{D}. CH_3 COOH + NaOH = CH_3 COONa + H_2 O$

Answer: C

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42. Heat of neutralisation is least when

A. NaOH is neutralised by CH_3COOH

B. NaOH is neutralised by HNO_3

C. NaOH is neutralised by HCl

D. NaOH is neutralised by H_2SO_4

Answer: A

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43. The standard heat of formation of U_3O_8 is -853.5 kcl//mol and the standard heat of the reaction $3UO_2 + O_2 \rightarrow U_3O_8$ is -76.01 Kcal.

The standard heat of formation of UO_2 is

A. $-1083 K Jmol^{-1}$

B. $-108.3 K Jmol^{-1}$

 $C. - 10.83 K Jmol^{-1}$

D. $-1.083 K Jmol^{-1}$

Answer: C

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44. Given $N_2(g)+3H(g)=2NH_3(g),$ $\Delta H^{\,\circ}=22$ kcal. The

standard enthalpy of formation of NH_3 gas is

A. -11Kcal/mol

B. 11Kcal/mol

C. - 22Kcal/mol

D. 22Kcal/mol

Answer: B

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45. ΔH for $CaCO_3(s) ightarrow CaO(s) + CO_2(g)$ is

$176 k Jmol^{-1}$ at 1240 K. The ΔE for the change is equal to

A. 160KJ

 $\mathsf{B}.\,165.6KJ$

 $\mathsf{C}.\,186.3KJ$

 $\mathsf{D}.\,180.0KJ$

Answer: A

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46. $C_{ ext{diamond}} + O_2(g) o CO_2(g), \Delta H = - 395 kJ$ (i)

 $C_{ ext{graphite}} + O_2(g)
ightarrow CO_2(g), \Delta H = - 393.5 KJ \quad \dots (ii)$

The ΔH , when diamond is formed from graphite, is

A. -1.5KJ

B. + 1.5 KJ

 ${\rm C.}+3.0KJ$

 $\mathrm{D.}-3.0KJ$

Answer: B



47. Given that

 $O(g) + e^-
ightarrow O^-(g)$, $\Delta H = 34 K calmol^{-1}$

$$O(g)+2e^{-}(g)
ightarrow O^{2-}(g)$$
 , $\Delta H=168Kcalmol^{-1}$

The enthalply change for the reaction

$$O^-(g)+e^-
ightarrow O^{2-}(g)$$
 is

A. $-202Kcalmol^{-1}$

B. $-134 K calmol^{-1}$

 $C. + 134 K calmol^{-1}$

 $D. + 202 K calmol^{-1}$

Answer: C

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48. The enthalpies of combustion of carbon and carbon momoxide are -390KJ respectively. The enthalpy of fomation of CO in KJ is

A. 668

 $\mathsf{B.}-12$

 $\mathsf{C.}-112$

 $\mathsf{D.}-668$

Answer: C

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49. 2.1g of Fe combines with S evoling 3.77KJ . The heat

oof formation of FeS in KJ/mol is

A. - 3.77

B. - 1.79

 $\mathsf{C.}-100.5$

D. none of these

Answer: C



50. The standard heat of combustion of propane is $-2220.1 K J mol^{-1}$. The standard heat of vaporisation of liquid water is $44.0 K J mol^{-1}$. What is ΔH° of $C_3 H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

 $\mathrm{A.}-2220.1KJ$

 $\mathrm{B.}-2044.1KJ$

 ${\rm C.}-2396.1KJ$

 $\mathsf{D.}-2176.1KJ$

Answer: C

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

A.
$$\Delta H_{f}^{\circ}(B_{2}O_{3})$$

B. $1/2\Delta H_{f}^{\circ}(B_{2}O_{3})$
C. $2\Delta H_{f}^{\circ}(B_{2}O_{3})$
D. $-1/2\Delta H_{f}^{\circ}(B_{2}O_{3})$

Answer: B



52. If $H^+ + OH^- o H_2O + 13.7Kcal$, the heat of neutralisation for complete neutralisation of 1 mole of H_2SO_4 by base will be

 ${\sf A.}\,13.7K cal$

 $\mathsf{B.}\,27.4K cal$

 $\mathsf{C.}\,6.85K cal$

 $\mathsf{D.}\ 3.425 K cal$

Answer: B



53. The heat of neutralisation of a strong acid and a strong alkali is $57.0 K Jmol^{-1}$. The heat released when 0.5 mole of

 HNO_3 solution is mixed with 0.2 mole of KOH is

A. 57.0KJ

 $\mathsf{B}.\,11.4KJ$

 $\mathsf{C.}\,28.5KJ$

D. 34.9KJ

Answer: B

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54. Based on the following thermochemical equations $H_2O(g) + C(s)
ightarrow CO(g) + H_2(g), \Delta H = 131KJ$ $CO(g) + 1/2O_2(g)
ightarrow CO_2(g), \Delta H = -282KJ$ $H_2(g) + 1/2_2(g)
ightarrow H_2O(g), \Delta H = -242KJ$

$$C(s)+O_2(g)
ightarrow CO_2(g), \Delta H=XKJ$$

The value of X will be

 $\mathrm{A.}-393KJ$

 $\mathrm{B.}-655KJ$

C. + 393KJ

 $\mathsf{D.}+655KJH$

Answer: B



55. If x_1 , x_2 and x_3 are enthalpies of H - H, O = O and O - H bonds respective, and x_4 is the enthaply of vaporisation of water, estimate the standard enthalpy opf combustion of bydrogen.

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

B. $x_1 + rac{x_2}{2} - 2x_3 - x_4$
C. $x_1 + rac{x_2}{2} - x_3 - x_4$
D. $2x_3 - x_1 - rac{x_2}{2} - x_4$

Answer: A

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56. The standard enthalpy of formation $(\Delta_f H^\circ)$ at 298K for methane $(CH_{4(g)})$ 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 hydrogen molecule, H_2

B. The dissociation energy of H_2 and enthlpy of

sublimation of carbon

C. Latent heat vaporisation of methane

D. The first four ionisation energies of carbon and

electron gain enthalpy of hydrogen

Answer: B



57. Heat of hydrogenation of ethene is x_1 and that of benzene is x_2 . Hence resonance energy of benezene is

A. $x_2 - 3x_1$

B. $x_1 + x_2$

C. $3x_1 - x_2$

D. $x_1 - 3x_2$

Answer: B

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58. Under the same conditions, how many mL of 1MKOHand $0.5MH_2SO_4$ solutions, respectively, when mixed to form a total volume of 100mL, produces the highest rise in temperature?

A. 67:33

B. 33:67

C. 40:60

D. 50:50

Answer: C



59. Bond energy of (N - H) bond is $yKJmol^{-1}$ under standard state. Thus, change in internal energy in the following process is

$$NH_3(g) o N(g) + 3H(g)$$

A. $-3yKJmol^{-1}$

B.
$$-yKJmol^{-1}$$

C. $3yKJmol^{-1}$

D. $yKJmol^{-1}$

Answer: D



60. The enthaplpy changes state for the following processes are listed below:

$$egin{aligned} Cl_2(g)&=2Cl(g):242.3KJmol^{-1}\ I_2(g)&=2I(g)$$
 , $151.0KJmol^{-1}\ ICl(g)&=I(g)+Cl(g):211.3KJmol^{-1}\ I_2(s)&=l_2(g)$, $62.76KJmol^{-1} \end{aligned}$

Given that the standard states for iodine chlorine are $I_2(s)$ and $Cl_2(g)$, the standard enthalpy of formation for ICl(g)is:

A.
$$+244.8 K Jmol^{-1}$$

$$B. - 14.6 K Jmol^{-1}$$

C. $-16.8 K Jmol^{-1}$

D. $+16.8 K Jmol^{-1}$

Answer: D

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61. For the equations

 $C1(ext{diamond}) + 2H_2(g) o CH_4(g), \Delta H_1$

 $C(g) + 4H(G)
ightarrow CH(g), \Delta H_2 1$

Predict whether

A.
$$\Delta H_1 = \Delta H_2$$

B. $\Delta H_1 > \Delta H_2$

C. $\Delta H_1 < \Delta H_2$

D.
$$\Delta H_1 = \Delta H_2$$

Answer: D

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62. If
$$H_2(g)=2H(g), \Delta H=104 cal$$
 , then heat of

atomisation of hydrogen is

A. 52Kcal

 $\mathsf{B.}\,104 cal$

 $\mathsf{C.}\,208K cal$

D. None of these

Answer: B



63. The average Xe - F bond energy is 34Kcal/mol, first I. E. Of Xe is 279Kcal/mol, electron affinity of F is 85Kcal/mol. Then, the enthalpy chnage for the reaction $XeF_4 \rightarrow Xe^+ + F^- + F_2 + F$ will be

A. 367 K cal / mol

B. 425Kcal/mol

C. 292Kcal/mol

D. 392Kcal/mol

Answer: A

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64. The standard enthalpy of formation of NH_3 is $-46.0KJmol^{-1}$. If the enthalpy of formation of H_2 from its atoms is $-436KJmol^{-1}$ and that of N_2 is $-712KJmol^{-1}$, the average bond enthalpy of N - H bond in NH_3 is

A. $-964 K Jmol^{-1}$

 $\mathsf{B.} + 352 K J mol^{-1}$

 $C. + 105 K Jmol^{-1}$

D. $-1102 K J mol^{-1}$

Answer: C



65. Given $H_2(g) = 2H(g)\Delta_{H-H} = 103Kcalmol^{-1}$

The heat of reaction of

 $CH_4(g) = CH_3(g) + H(g)$

A. $103K calmol^{-1}$

B. $206 K calmol^{-1}$

C. $51.5K calmol^{-1}$

D. zero

Answer: B



66. Energy required to dissociate 4g of gaseous hydrogen

into free gaseous atoms is 208 K cal at $25\,^{\circ}C$

The bond energy of H - H bond will be

A. 104Kcal

 $\mathsf{B.}\,10.4K cal$

 $\mathsf{C.}\,1040K cal$

D. 1.40 K cal

Answer: D



67. The H - H bond energy is $430KJmol^{-1}$ and Cl - Cl bonds is 240KJ mol^{-1} . DeltaHf or HClis-90KJ. TheH-Cl` bond energy is about.

A. $425 K J mol^{-1}$

B. $KJmol^{-1}$

C. $360 mol^{-1}$

D. $180 mol^{-1}$

Answer: A

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68. Given the bond energies N = N, H and H - H bond are 945, 436 and $391 K Jmol^{-1}$ respectively, the enthalpy change of the reaction

 $N_2(g)+3H_2(g)
ightarrow 2NH_3(g)$ is

A. -93KJ

В. 102*KJ*

C. 90*KJ*

D. 105*KJ*

Answer: A

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69. AB, A_2 and B_2 are diatomic molecules, if the bond enthalpies of A_2 , AB and B_2 are in the ratio of 1:1:0.5 and the enthaly of formation of AB from A_2 gives AO and $\Delta H_c = -1200 K J mol^{-1}$. Bond energy of (O = O) bond is $500 K J mol^{-1}$. What is the bond enthalpy of (A - O)bond ?

A. 400 K J mol - 1

B. 1650 KJmol - 1

C.1200 KJmol - 1

 $\mathsf{D.}\ 200 KJmol-1$

Answer: A

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70. The standard enthalpies of formation of $SF_6(g)$, S(g)and F(g) are -1150, +280 and $+85KJmol^{-1}$. Thus, average bond energy of (S - F) in SF_6 is

A. 309.16*KJmol*⁻¹

B. $1855 K J mol^{-1}$

C. $11.130 imes 10^3 KJmol^{-1}$

D. 323.33*KJmol*⁻¹

Answer: D



71. Using bond enthalpies (symbolized by arepsilon) an estimated value of ΔH° for the reaction $H_2C=CH_2(g)+H_2(g) o CH_3-CH_3(g)$ would be

A.
$$arepsilon_{C=C}+arepsilon_{H-H}-2arepsilon_{C-H}-arepsilon_{C-C}$$

$$\mathsf{B}.\,\varepsilon_{C=C}+\varepsilon_{H-H}-6\varepsilon_{C-H}-\varepsilon_{C-C}$$

C.
$$arepsilon_{C=C}+arepsilon_{H-H}-4arepsilon_{C-H}-arepsilon_{C-C}$$

D.
$$arepsilon_{C=C}+arepsilon_{H-H}-4arepsilon_{C-H}-arepsilon_{C-C}$$

Answer: D

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72. The heat of formation of CO_2 is -407KJ/mol . The energy required for the process $3CO_2(g) o 3C(g) + 2O_3(g)$ is

A. less than 1221 KJ

B. more than 1221KJ

C. is equal to 1221KJ

D. cannot be predicted

Answer: B



73. Heat evolved in the reaction

 $H_2+Cl_2
ightarrow 2HCl\,$ is 182 kJ Bond energies H- H = 430 kJ/mole, $Cl-Cl=242kJ/{
m mole}.$ The H-Cl bond energy is

A. $245 K J mol^{-1}$

B. $427 K J mol^{-1}$

C. $336 K J mol^{-1}$

D. $154 K J mol^{-1}$

Answer: B



74. Enthalpy of formation of 2mol of $NH_3(g)$ is -90KJ ,

and $\Delta H_{H\,-\,H}$ and $\Delta H_{N\,-\,H}$ respectively $435 K J mol^{-1}$ and

 $390 K J mol^{-1}$. The valule of $\Delta H_{N\,\equiv\,N}$ is

 ${\rm A.}-472.5KJ$

B. $-945 K Jmol^{-1}$

 $\mathsf{C.}\,472.5KJ$

D. $945KJmol^{-1}$

Answer: A



75. Oxidising power of chlorine in aqueous solution can be

determined by the parameters indicated below

$$egin{aligned} &rac{1}{2}CL_2(g) \stackrel{rac{1}{2}\Delta_{diss}\,H^{\,\Theta}}{\longrightarrow} Cl(g) \stackrel{\Delta H^{\,\Theta}_{Eg}}{\longrightarrow} \ Cl^{-}(g) \stackrel{\Delta_{hyd}\,H^{\,\Theta}}{\longrightarrow} Cl^{-}(aq) \end{aligned}$$
The energy involved in the conversion of $rac{1}{2}Cl_2(g)$ to

 $Cl^{-}(aq)$

(Using the data $\Delta_{diss} H^{\,\Theta}_{Cl_2} = 240 K J mol^{-1}$)

 $\Delta_{Eg}H^{\,\Theta}_{Cl}=~-~349KJmol^{-1}$, $\Delta_{Eg}H^{\,\Theta}_{Cl}=~-~381KJmol^{-1}$) will be

A. + 152c

- B. $-610 K Jmol^{-1}$
- C. $-850 K Jmol^{-1}$
- D. $+120KJmol^{-1}$

Answer: D



76. The value of ΔH_{O-H} is 109Kcal/mol . The enthalpy of formation of 1 mole of water in gaseous state will be

A. $109 imes 2KJmol^{-1}$

B. $109KJmol^{-1}$

C. data is not sufficient to predict it

D. $109 imes 4 K calmol^{-1}$

Answer: B

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Entropy, Gibb'S Energy And Spontaneity Of Process

1. Calculate the entropy change when 3.6g of liquid water is completely converted into vapour at $100^{\circ}C$. The molar heat of vaporization is $40.85 K Jmol^{-1}$.

A. $6.08 JK^{-1}$

B. $109.5 JK^{-1}$

C. $21.89 JK^{-1}$

D. $-21.89 JK^{-1}$

Answer: C



2. In an irreversible process taking place at constant P and T

in which only pressure volume work is being done by the

system the change in Gibb's energy (ΔG) and change in entropy (Δ) , satisfy the criterion:

$$\begin{array}{l} \mathsf{A}.\,(\Delta S)_{V.\,U} = 0,\,(\Delta G)_{T.\,P} = 0\\\\ \mathsf{B}.\,(\Delta S)_{V.\,U} = 0,\,(\Delta G)_{T.\,P} = \,+\,ve\\\\ \mathsf{C}.\,(\Delta S)_{V.\,U} = 0,\,(\Delta G)_{T.\,P} = \,-\,ve\\\\ \mathsf{D}.\,(\Delta S)_{V.\,U} = 0,\,(\Delta G)_{T.\,P} = \,-\,ve\end{array}$$

Answer: C

3. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K_c is:

A.
$$\Delta G^\circ = RT$$
 ln K_C

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B. $-\Delta G^\circ = RT \ln K_C$

C.
$$\Delta G = RT \ln K_C$$

D. – $\Delta G = RT \ln K_C$

Answer: D



4. Predict which of the following reaction (s) has a positive entropy change?

I . $Ag^+(aq)+Cl^-(aq)
ightarrow AgCl(s)$

 $II \,.\, NH_4Cl(s)
ightarrow NH_3(g) + HCl(g)$

 $III\,.\,2NH_3(g)
ightarrow N_2+3H_2(g)$

A. I and II

B. III

C. II and III

D. II

Answer: B



5. Maxing of non-reacting gases is generally accompanied by

A. `Decreases in enthropy

B. Increases in entropy

C. Change in enthalpy

D. Change in free energy

Answer: C

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6. A particular state of system is arrived at starting from a given state in two different ways (1) following reversible path and (2) irreversible path. Which of the following relations would be correct if the processes are isothermal ?

A.
$$\Delta S_{rev}
eq \Delta S_{irrev}$$

B.
$$\Delta q_{rev} = \Delta q_{irrev}$$

C.
$$\Delta S_{rev} = \Delta S_{irrev} = rac{\Delta q_{rev}}{T}$$

D.
$$\Delta S_{irrev} = rac{\Delta q_{irrev}}{T}
eq \Delta S_{rev}$$

Answer: B



7. For a spontaneous reaction, ΔG , equilibrium constant (K)and E_{cell}^0 will be respectively :

 $\mathsf{A}.-ve, > 1, +ve$

 $\mathsf{B.} + ve, > 1, -ve$

 $\mathsf{C}.-ve,\ <1,\ -ve$

D. -ve, > 1, -ve

Answer: A



8. For the water gas reaction $C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$ At 1000K, the standard Gibbs free energy change of the reaction is -8.314KJ/mol. Therefore, at 1000K the equilibrium constant of the above water gas reaction is

A. 1

 $\mathsf{B.}\,10$

C. $\frac{1}{e}$

D. 2.718

Answer: A

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9. At 500K, for an isobaric pracess.

$$\Delta S_{system} = \ - \ 10 rac{KJ}{molK}$$
 and $\Delta S_{surr} = \ 12 rac{KJ}{molK}$

Therefore, ΔG for the entire process is

A. -500 KJ/mol

 $\mathrm{B.}-1000 KJ/mol$

C.-600KJ/mol

D. - 1100 KJ/mol

Answer: D



10. Identify the correct statement regarding a spontaneous

process:

A. For a spontaneous process in an isolated system, the

change in entropy is positive

B. Endothermic process are never spontaneous

C. Exothermic processes are always spontaneous

D. Lowering of energy in the reaction process is the only

criterion for spontaneity

Answer: B



11. Standard entropt of X_2 , Y_2 and XY_3 are $60,\,40$ and

 $50JK^{-1}mol^{-1}$, respectively. For the reaction, $rac{1}{2}X_2+rac{3}{2}Y_2 o XY_3, \Delta H=-30KJ$, to be at equilibrium, the temperature will be:

A. 1250K

 $\mathsf{B.}\,500K$

 $\mathsf{C.}\,750K$

D. 1000K

Answer: A

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12. If liquids A and B from an ideal solution,

A. The entropy of mixing is zero

B. The Gibbs free energy as well as the entropy of mixing

are zero

C. The Gibbs free energy as well as the enthalpy of mixing

are zero

D. The enthalpy of mixing is zero

Answer: C

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13. Which reaction, with the following value of ΔH and ΔS at 350K is spontaneous and endothermic?

 $\Delta HKJmol^{-1}\Delta SKJmol^{-1}\Delta HKJmol^{-1}\Delta SKJmol^{-1}$

A. $-48, +135 \times 10^{-3}$

B. - 48, -135

C. +48, +135 \times 10⁻³

D.
$$+48, -135 imes 10^{-3}$$

Answer: D

14. The incorrect expression among the following is

A.
$$\frac{\Delta G_{\text{system}}}{\Delta G_{\text{total}}} = -T$$

B. in isothermal process, $W_{\text{reversible}} = -nRT \text{in} \frac{V_f}{V_i}$
C. In $K = \frac{\Delta H - T\Delta S^{\circ}}{RT}$
D. $K = e^{-\Delta G^{\circ}/RT}$

Answer: C

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15. Which of the following reactions is associated with the most negative change in entropy?

A.
$$2SO_2(g)+O_2(g) o 2SO_3(g)$$

B. $C_2H_4(g)+H_2(g) o C_3H_6(g)$
C. $C(s, \;\; ext{graphite})+O_2 o CO_2(g)$
D. $3C_2H_2(g) o C_6H_6(g)$

Answer: C

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16. For the reaction in the plant cells

 $6CO_2(g) + 12H_2O(l)
ightarrow C_6H_{12}O_6(s) + 6O_2(g)$

 $+ 6 H_2 O(l) \Delta_r G^0 = 3000 KJ/mol$

 $ATP
ightarrow ADP + PO_4^{3-} \Delta_r G^0 = - 30 KJ/mol$ Glucose is stored in the plant cell as starch $(C_6 H_{10} O_5)_n$. To produce 162g of starch how many moles of ATP are minimum required?

A. 100mol

 $\mathsf{B.}\,10mol$

 $\mathsf{C.}\,20mol$

 $\mathsf{D.}\ 200 mol$

Answer: D



17. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of $10 dm^3$

to a volume of $100 dm^3$ at $27^\circ C$ is

A. $38.3JK^{-1}$

B. $35.8 JK^{-1}$

C. $32.3 J K^{-1}$

D. $42.3 JK^{-1}$

Answer: A

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18. In view of the signs of $\Delta_r G^0$ for the following reactions

 $PbO_2+Pb
ightarrow 2PbO, \Delta_r G^0 < 0$

 $SnO_2+Sn
ightarrow 2SnO, \Delta_r G^0>0$

Which oxidation state are more characteristic for lead and

tin?

A. For lead +4 , for tin +2

B. For lead +2 , for tin +2

C. For lead +4 , for tin +4

D. For lead +2 , for tin +4

Answer: A

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19. Two moles of an ideal gas is expanded irreversibly and isothermally at $37^{\circ}C$ until its volume is doubled and 3.41KJ heat is absorbed from surrounding. P $\Delta S_{\rm total}$ (system +surrounding) is:

A. -0.52 J/K

B. 0.52 J / K

C. 22.52J/K

 $\mathsf{D}.\,0$

Answer: B



20. A spontaneous change is one in which a system under

goes

A. an increases in internal energy

B. a lowering of entropy

C. a lowering of free energy

D. no energy change

Answer: B



21.
$$C_2H_6(g) + 3.5)_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$$

 $\Delta S_{vap}(H_2O, l) = x_1calK^{-1}$ (boiling point $= T_1$)
 $\Delta H_f(H_2O, l) = x_2$
 $\Delta H_f(CO_2) = x_3$
 $\Delta H_f(C_2H_6) = x_4$
Hence, ΔH for the reaction is

A.
$$2x_3 + 3x_2 - x_4$$

B. $2x_3 + 3x_2 - x_4 + 3x_1T_1$
C. $2x + 3x_2 - x_4 + 3x_1T_1$
D. $x_1T_1 + x_2 + x_3 - x_4$

Answer: C



22. When reaction is at standard state at equilibrium, then

A. $\Delta H^{\,\circ}\,=0$

B. $\Delta S^{\,\circ}\,=0$

C. equilibrium constant K = 0

D. equilibrium constant K = 1

Answer: B



23. A spontaneous change is one in which a system under goes

A. $T_e > T$

 $B.T > T_e$

C. $T_e \ {\rm is} \ 5 \ {\rm times} \ T$

D. $T = T_e$

Answer: D

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24. When reaction is at standard state at equilibrium, then

 $\mathbf{B.\,87~\%}$

 $\mathsf{C}.\,90~\%$

D. $97\,\%$

Answer: B



25. For a spontaneous chemical process, the free energy change is

A. positive

B. negative

C. either positive or negative

D. zero

Answer: D

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26. A reaction has $\Delta H = -33KJ$ and $\Delta S = -58\frac{J}{H}$. This reaction would be:

A. spontanceous at all temperatures

B. non-spontaneous at all temperatures

C. spontaneous above a certain temperature

D. spontaneous below a certain temperature

Answer: B

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27. Which of the following statement (s) is/are correct? Statement (i) : The entropy of isolated system with P - Vwork only is always maximized at euilibrium. Stetement (ii) : It is possible for the entropy of close system to decreases substantilly in an irreversible process. Statement (iii) : Entropy can be created but not be destroyed.

Statement (iv) : ΔS system is zero for reversible process in an isolated system.

A. Statements I, ii, iii,

B. Statement *ii*, *iv*

C. Statement I, ii, iv

D. All of these

Answer: D



28. The process of evaporation of a liquid is accompanied by

A. an increases in entropy

B. a decreases in entropy

C. no change in entropy

D. no change in free energy

Answer: D



29. During winters, moisture condenses in the from of dew and can be seen on plant leaves and grass. The entropy of

the system in such cases decreases as liquids process lesser disorder as compared to gases. With reference to the second law, which statement is correct. for the above process?

A. The randomness of the universe decreases

B. The randomness of the surroundings decreases

C. Increases in randomness of surrroundings equals ito

the decreases in randomness of system

D. The increases in randomness of the surroundings is

greater as compared to the decreases in randomness

of the system.

Answer: A

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30. Combustion of sucrose is used by aerobic oranisms for providing energy for the life sustaining processes. If all the capturing of energy from reaction is done through electrical process (non P - V work), then calculate maximum available energy which can be captured by combustion of 34.2g of sucrose.

Given, $\Delta H_{
m combustion}(
m surrose)=~-~6000 K Jmol^{-1}$

 $\Delta S_{
m combustion} = 180 J/K - mol$ and body temperatuire is300 K

A. 600KJ

 $\mathsf{B.}\,594.6KJ$

 $\mathsf{C.}\,5.4KJ$

D. 605.4*KJ*

Answer: D



31. At $0^\circ C$, ice and water are in equilibrium and ΔS and ΔG for the conversion of ice to liquid water is

A. 0, $21.98 J K^{-1} mol^{-1}$

B. - ve, zero

 $C. + ve, 21.98 JK k^{-1} mol^{-1}$

D. All of these

Answer: D



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

temperature

A. $\Delta H < 0, \Delta S > 0$

B. $\Delta H < 0, \Delta S < 0$

 $\mathsf{C}.\,\Delta H>0,\,\Delta S>0$

D. None of these

Answer: C

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33. When a bottle of perfume is opened, odorous molecules mix with air and slowly diffuse throughout the entire room. Which is not correct for this process?

A. $\Delta G < 0$

B. $\Delta S > 0$

C. $\Delta sHpprox 0$

D. $\Delta S < 0$

Answer: A

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34. Change in entropy is negative for

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

B.
$$C(s)+H_2O(g)
ightarrow CO(g)+H_2(g)$$

 $\mathsf{C}.\, N_2(g, 10atm) \rightarrow N_2(g, 1atm)$

D. $Fe(1mol, 400K) \rightarrow Fe(1mol, 300K)$

Answer: B

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35. In which of the following reactions ΔS is positive?

A.
$$H_2O(l) o H_2 + O(s)$$

B. $3O_2
ightarrow 2O_3(g)$

C.
$$H_2O(l) o H_2O(g)$$

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

Answer: D

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36. The molar enthlpy of fusion of water is $6.01 K Jmol^{-1}$. The entropy change of 1 mol of water at its melting point will be

A.
$$22 Jmol^{-1}K^{-1}$$

B. $109 Jmol^{-1}K^{-1}$

C. $44 Jmol^{-1}K^{-1}$

D. spontaneous below a certain temperature

Answer: A



37. When ice melts into water, entropy

A. Becomes zero

B. Decreases

C. Increases in randomness of surrroundings equals ito

the decreases in randomness of system

D. Remains same

Answer: A

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38. The value of free energy change of an equilibrium process

is

A. positive

B. Negative

C. Zero

D. Not definite

Answer: C

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

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

B. $-9.78 JK^{-1}$ mol^(-1)`

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

D. Zero

Answer: C

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40. One mole of an ideal gas at $25^{\circ}C$ is subjected to expand reversible ten times of its intial volume. The change in entropy of expansion is

A. $19.15 JK^{-1} mol^{-1}$

B. $16.15 JK^{-1} mol^{-1}$

C. $22.15 JK^{-1}mol^{-1}$

D. None

Answer: A


41. The entropy change for the reaction given below is $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ is ... At 300K. Standard entropies of $H_2(g), O_2(g)$ and $H_2O(l)$ are 126.6, 201.20 and $68.0JK^{-1}mol^{-1}$ respectively.

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

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

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

D. None of these

Answer: A



42. The a reaction to be spontaneous at all temperature

A. ΔG and ΔH should be negative

B. ΔG for the reaction is zero

C. ΔG and ΔH should be positive

D. $\Delta H < \Delta G$

Answer: A

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43. Which of the following statements is true? The entropy of

the universe

A. Increases and moves towards maximumm value

B. Decreases and moves to zero

C. Remains constant

D. Decreases and increases with a periodic rrate

Answer: A

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44. Enthalpy of fusion of a liquid is $1.435Kcalmol^{-1}$ and molar entropy change is $5.26calmol^{-1}K^{-1}$ Hence melting point of liquid is

A. $100\,^\circ\,C$

 B.0°

 $\mathsf{C.}\,373K$

D. $-273^{\,\circ}\,C$

Answer: A

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45. If S° for H_2, Cl_2 and HCL are 0.13, 0.22 and $0.19KJK^{-1}mol^{-1}$ respectively. The total change in standard entropy for the reaction $H_2 + Cl_2 \rightarrow 2HCl$ is

A.
$$0.5 KJK^{-1}mol^{-1}$$

- B. $40JK^{-1}mol^{-1}$
- C. $60JK^{-1}mol^{-1}$

D.
$$20JK^{-1}mol^{-1}$$



46. If the enthalpy of vaporization for water is $198.5 K Jmol^{-1}$, the entropy of its vaprization will be

A. $0.5 KJ^{-1}$

- B. $1.0KJK^{-1}mol^{-1}$
- C. $1.5KJK^{-1}mol^{-1}$
- D. $2.0KJK^{-1}mol^{-1}$

Answer: A



47. In the following Table, which one is correct

 $\Delta H \Delta S$ Nature of reaction

A. (-)(+) Spontaneous only at high temperature

B. (+)(-) Spontaneous regardless of temperature

C. (+)(+) Spontaneous only at low temperature

D. (-)(-) Spontaneous at all temperature

Answer: A

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48. For the reaction,

 $X_2O_4(l)
ightarrow 2XO_2(g), \Delta E=2.1 K cal$,

 $\Delta S = 20 cal\,/\,K$ at 300 K . Hence ΔG is

 ${\rm A.}\ 2.7 K cal$

 ${\rm B.}-2.7 K cal$

 ${\rm C.}\,9.3K cal$

 ${\rm D.}-9.3 K cal$

Answer: B

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49. The temperature at which the reaction,

 $Ag_2O(s)
ightarrow 2Ag(s) + 1/2O_2(g)$

Is at equilibrium is ..., Given $\Delta H = 30.5 K Jmol^{-1}$ and ΔS

 $= 0.066 K J K^{-1}$

A. 462.12K

 $\mathsf{B}.\,362.12K$

 $\mathsf{C.}\ 262.12K$

 $\mathsf{D}.\,562.12K$

Answer: B

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50. Given

(I)

C(diamond)

+

 $+ O_2(g) o CO_2(g), \Delta H^{\,\circ} = \, - \, 92.0 K calmol^{\,-1}$

(II) C(graphite)

 $O_2(g)
ightarrow CO_2(g), \Delta H^{\,\circ} \ = \ -\ 96.0 K calmol^{\,-1}$

A. $2.907 K cal K^{-1}$

B. $2.013 K cal K^{-1}$

C. $305.4 cal K^{-1}$

D. $-2.013KcalK^{-1}$

Answer: A



51. For a certain reaction XrarrY the value of ΔH and ΔS are $50.50 K J mol^{-1}$ and $100.03 J K^{-1}$ respectively. The temperature at which $\Delta G = 0$ is

 $\frac{1}{2} = 0$

A. $505^{\,\circ}\,C$

B. $232^{\,\circ}\,C$

C. $252^{\circ}C$

D. $450^{\,\circ}\,C$

Answer: A



52. Which of the following processes process towards more disordered state?

I Stretching the rubberII. Sublimation of dry ice *III* Crystallisation of salt from solution

 ${\it IV}$. Dissolution of sugar from solution

A. I, II, IV

 $\mathsf{B}.\,I,III$

 $\mathsf{C}.\,III,\,IV$

$\mathsf{D}.\,II,\,IV$

Answer: B

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Heat Capacity And Calorimetry

1. The temperature of a 5ml of storng acid increases by $5^{\circ}C$ when 5mol of a strong base is added to it. If 10ml of each is mixed, temperature should increases by

A. $5^{\,\circ}\,C$

B. $10^{\circ}C$

C. $15^{\,\circ}\,C$

D. Cannot be known

Answer: A



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

A. Violates first law of thermodynamics

B. Violates first law of thermodynamics if $Q_1 = -ve$

C. Violates first law of thermodynamics if $Q_2 = -ve$

D. Does not violates first law of thermodynamics

Answer: A



- 3. The heat required to raise the temperature of body by
- $1^{\circ}C$ is called:
 - A. Specific heat
 - B. Thermal capacity
 - C. Water equivalent
 - D. None of these
- Answer: D



4. If for an ideal gas, the ratio of pressure and volume is constant and is equal to 1 atm L^{-1} , the molar heat capacity at constant pressure would be

A. $\frac{3}{2}R$ B. 2RC. $\frac{5}{2}R$

D. zero

Answer: C



5. For the complete combustion of ethanol, $C_2H_5OH(l)+3O_2(g)
ightarrow 2CO_2(g)+3H_2O(l)$ the amount

of heat produced as measured in bomb calorimeter is $1364.47 K Jmol^{-1}$ at $25^{\circ}C$. Assuming ideality, the enthalpy of combustion, ΔH_C , for the reaction will be

 $\left[R = 8.314 J K^{-1} mol^{-1}\right]$

A. $-1366.95 K Jmol^{-1}$

B. $-1361.95 K Jmol^{-1}$

 $C. - 1460.50 K Jmol^{-1}$

D. $-1350 K Jmol^{-1}$

Answer: A



6. The reaction of cyanamide $NH_2CN(s)$ with oxygen was carries out in a bomb calorimeter and Δq_v at 300K was

measured to be -750 KJ/mol . The value of ΔH per mole of $NH_2 CN(s)$ in the given reaction is

 $\mathsf{A.}-741.75KJ/mol$

B.-748.75 KJ/mol

 $\mathsf{C.}-752.75KJ/mol$

D. - 750 KJ/mol

Answer: A



7.
$$rac{1}{2}N_2(g)+O_2
ightarrow NO_2(g), \Delta_r H^{\,\circ}=\ -\ 40 KJ/mol$$

Given:

 $C_{P\,.\,m}(NO_2,g) = 40 J \,/\,mol \,/\,K, C_{p\,,m}(O_2,g) = 30 J K^{-1} mol^{-1}$

$$C_{P\,,m}N_2(g)=30JK^{-1}mol^{-1}$$

What is the enthalpy of formation of $NO_2(g)$ at 1298K?

A.
$$-40KJ/mol$$

- B. 50 KJ/mol
- C. 45KJ/mol
- D. 6KJ/mol

Answer: B



8. What percentage T_1 is of T_2 for a 10 % efficiency of a heat engine? T_1 is the temperature of sink and T_2 is the temperature of heat reservoir. A. $T_1=90\,\%\,$ of T_2

B.
$$T_1 = T_2$$

C. $T_2=90\,\%\,$ of T_1

D. $T_1=50~\%$ of T_2

Answer: C

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9. When 20mL of a strong acid is added to 20mL of an alkali, the temperature rises by $5^{\circ}C$. If 200mL of each liquid is mixed, the temperature rise will be

A. $5^{\,\circ}\,C$

B. $50^{\circ}C$

C. $20^{\circ}C$

D. $0.5^{\,\circ}\,C$

Answer: A

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10. Calculate the maximum efficiency of an engine operating between $110^{\,\circ}\,C$ and $25^{\,\circ}\,C$.

A. 11.1 %

 $\mathsf{B}.\,22.2~\%$

C. 33.3 %

D. 44.4 %

Answer: A

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11. The ammount of heat required to raise the temperature of 1 mole of diatomic gas by $1^{\circ}C$ at constant pressure is 60cal. The amount of heat which goes as internal energy of the gas is nearly.

A. 60Cal

 $\mathsf{B.}\, 30 Cal$

 $\mathsf{C.}\,42.6Cal$

 $\mathsf{D.}\,49.8Cal$



12. Molar heat capacity of water in equilibrium with ice at constant pressure is

A. Zero

B. Infinity (∞)

C. $40.45 KJK^{-1}mol^{-1}$

D. $75.48 J K^{-1} mol^{-1}$



13. In which cases of maxing of a strong acid and a base each of 1N concentration, increases in temperature is the highest.

A. 20ml acid -30ml alkali

B. 10ml acid -40ml alkali

C. 25ml acid -25ml alkali

D. 35ml acid -15ml alkali

Answer: B

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Section B - Assertion Reasoning

1. Assertion: The enthalpy of formation of geseous oxygen molecules at 298K and under of 1 atm is zero.

Reason: The entropy of formation of gaseous oxygen molecules under the same condition is zero.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: C



2. Assertion: We feel cold on touching the ice.

Reason: Ice is a solid form of water.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.



3. Assertion: Entropy of ice is less than water. Reason: Ice has cage-like structure.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.



4. Assertion: The heat absorbed during the isothermal expansion of an ideal gas againts vacuum is zero.

Reason: The volume occupied by the molecules of an ideal gas is zero.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

5. Assertion: Mass and volume are extensive properties.

Reason: Mass/volume is also an extensive parameter.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: C



6. Assertion: ΔH and ΔE are almost the same for the reaction. $N_2(g)+O_2(g) \Leftrightarrow 2NO_g$

Reason: All reactants and products are gases.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: B

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7. Assertion: Work and internal energy are not state functions.

Reason: The sum of q + w is a state function.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: B

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8. Assertion: The zeroth law of thermodynamics was know before the first law of thermodynamics.

Reason: The zeroth law concerning thermal equilibrium appeared after three laws (I, II and III) of thermodynamics and thus was named zeroth law.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

- C. If the assertion is true but reason is false.
- D. If assertion is false but reason is true.

9. Assertion: A non-spontaneous endothermic reaction at room temperature may be spontaneous at high temperature. Reason: At high temperature $T\Delta S$ becomes more than ΔH .

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

- C. If the assertion is true but reason is false.
- D. If assertion is false but reason is true.

Answer: D



10. Assertion (A) : There is a natural asymmetry between converting work to heat and converting heat of work.
Reason (R): No process is possible in which the sole result is the absorption of heat from a reservoir and its complete conversion into work.

A. If both the assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



11. Assertion: Kinetic energy of photoelectrons is directly proportinal of the intensity of the incident radiation.Reason: Each photo of light causes the emission of only one photoelectron.

A. If both the assertion and reason are true and the reason is the correct explanation of the assertion.B. If both the assertion and reason are true but reason is not the correct explantion of the assertion.C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



12. Assertion: An exothermic reaction in principle cannot have zero activation energy.

Reason: In exothermic reaction ΣH (Products) $<\Sigma H$ (Reactants).

A. If both the assertion and reason are true and the reason is the correct explanation of the assertion.B. If both the assertion and reason are true but reason is not the correct explantion of the assertion.C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.



13. Assertion: When a real gas is allowed to expand adiabatically through a fine hole from a region of high presssure to a region of low pressure, the temperature of gas falls in a completely insulated container.

Reason: Work is done at the cost of internal energy of the gas.

- A. If both the assertion and reason are true and the reason is the correct explanation of the assertion.
- B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: D

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14. Assertion: For any gas $\Delta W = -P\Delta V, P$ represents the external pressure.

Reason: Throughout the process, external pressure must be remain constant.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.
C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A

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15. Assertion: Where a mole of electron is transported across a potential difference of 1V from positive electrode to negative electrode, then work done is -96500J. Reason: Work done due to transportation of electrons depends on the product of potential difference between the

two points and amount to charge carried.

A. If both the assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



16. Assertion: The product of pressure and volume for a fixed amount of gas is equal to a constant represented by RTReason: At constant temperature, for a fixed amount of a gas, pressure is inversely proportional to volume. A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



17. Assertion: Adsorption is exothermic and spontaneous in spite of the fact that adsorption is accompanied with deccrease in entropy.

Reason: The factor $T\Delta S$ is lesser than ΔH

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: D



AIPMT/ NEET Questions

1. When 1 mole of gas is heated at constant volume. Temperature is raised from 298 to 308K. Heat supplied to the gas is 500J. Then which stamenet is correct?

A.
$$q=~-W=500J,$$
 $\Delta U=0$

B. $q=\Delta U=500J, W=0$

C.
$$q=~-W=500J,$$
 $\Delta U=0$

D.
$$\Delta U=0, q=W=-500J$$

Answer: C



2.
$$PbO_2
ightarrow PbO, \Delta G_{298} < 0$$

 $SnO_2
ightarrow SnO, \Delta G_{298} > 0$

Most proble oxidation states of Pb and Sn will be

A.
$$Pb^{4+}$$
, Sn^{4+}
B. Pb^{4+} , Sn^{2+}
C. Pb^{2+} , Sn^{2+}
D. Pb^{2+} , Sn^{4+}

Answer: B



-286 KJ/mol respectively is

A. -196 KJ/mol

B. + 196 KJ/mol

C. + 948 KJ/mol

D. - 948 KJ/mol

Answer: D

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4. Enthalpy of
$$CH_4 + rac{1}{2}O_2 o CH_3OH$$
 is

negative. If enthalpy of combustion of CH_4 and CH_4OH are

x and y respectively, then which relation is correct?

A. x > y

 $\mathsf{B.}\, x < y$

 $\mathsf{C}. x = y$

 $\mathsf{D}.\, x \geq y$

Answer: B

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5. The unit of entropy is

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

B. $KJ^{-1}mol^{-1}$

C. $KJmol^{-1}$

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

Answer: A



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

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

B.
$$\Delta U + W = q
eq 0$$

C.
$$\Delta U + Q, W = q
eq 0$$

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

Answer: A



7. Two moles of ideal gas at $27^{\circ}C$ temperature is expanded reversibly from 2 litre to 20 liter. Find entropy change (R = 2cal/molK).

A.92.1

 $\mathsf{B.}\,0$

C. 4

 $\mathsf{D}.\,9.2$

Answer: D



8. Heat of combustion $\Delta H^{\,\circ}\,$ for $C(s),\,H_2(g)$ and $CH_4(g)$

are 94,~-68 and -213 K cal / mol . Then $\Delta H^{\,\circ}$ for

 $C(s)+2H_2(g)
ightarrow \Delta CH_4(g)$ is

 ${\rm A.}-17 K cal$

 $\mathsf{B.}\,111Kcal$

 $\mathsf{C.}-170 K cal$

D. - 85 K cal

Answer: D



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

A. 1.2K

 $\mathsf{B.}\,2.4K$

 $\mathsf{C.}\,4.8K$

 $\mathsf{D.}\,6.6K$

Answer: B

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10. What is the entropy change (in $JK^{-1}mol^{-1}$) when one mole of ice is converted into water at $0^{\circ}C$? (The enthalpy change for the conversion of ice to liquid water is $6.0KJmol^{-1}$ at $0^{\circ}C$)

A. 20.13

B. 2.013

C. 2.198

D. 21.98

Answer: B



11. For which one of the following equation is $\Delta H^{\,\circ}_{reaction}$ equal to $\Delta H^{\,\circ}_{f}$ for the product ?

A.
$$N_2(g)+O_3(g) o N_2O_3(g)$$

B. $CH_4(g)+2Cl_2(g)
ightarrow CH_2Cl_2(l)+2HCl(g)$

 $\mathsf{C}.\, Xe(g)+2F_2(g) \to XeF_4(g)$

D. $2CO(g) + O_2(g)
ightarrow 2CO_2(g)$

Answer: D

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12. For the reaction

 $C_3H_8(g)+5O_2
ightarrow 3CO_3(g)+4H_2O(l)$

at constant temperature, $\Delta H - \Delta U$ is

A. +RT

B.-3RT

C. + 3RT

D. - RT

Answer: C



13. The densities of graphite and diamond at 298K are 2.25and $3.31gcm^{-3}$, respectively. If the standard free energy difference (ΔG^0) is equal to $1895Jmol^{-1}$, the pressure at which graphite will be transformed into diamond at 298K is

A. 9.92 imes 106 Pa

 $\texttt{B.}~9.92\times105Pa$

C. 9.92 imes 108 Pa

D. 9.92 imes 107 Pa

Answer: B



14. Considering entropy $\left(S
ight)$ as a thermodynamics parameter,

the criterion for the spontaneity of any process is

A.
$$\Delta S_{
m system} + \Delta S_{
m surrounding} be + ve$$

B. $\Delta S_{
m system} - \Delta S_{
m surroundings} be$ +ve

C. $\Delta S_{
m system}$ be zero

D. $\Delta S_{
m surroundings} be$ zero

Answer: C

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15. Standard enthalpy and standard entropy change for the oxidation of NH_3 at 298K are $-382.64KJmol^{-1}$ and

 $145.6 Jmol^{-1}$ respectively. Standard free energy change for

the same reaction at 298K is

A. $-221.1 K Jmol^{-1}$

B. - 339.3*K*Jmol⁻¹

C. -439.3*KJmol*⁻¹

D. $-523.2 K J mol^{-1}$

Answer: A



16. The work done during the expansion of a gas from a volume of $4dm^3$ to $6dm^3$ againts a constant external presuure of 3atm is (1atm - L = 101.32J)

A. -6J

 $\mathrm{B.}-608J$

 $\mathsf{C.}+304J$

 $\mathrm{D.}-304J$

Answer: B

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17. The bond energies of H - -H , Br - -Br and H - -Br are 433, , 192 and $364KJmol^{-1}$ respectively. The ΔH° for the reaction $H_2(g) + Br_2(g) \to 2HBr(g)$ is

A. 261KJ

 $\mathbf{B.}+103KJ$

 ${\rm C.}+261KJ$

 $\mathrm{D.}-103KJ$

Answer: B



18. The absolute enthalpy of neutralization of the reaction,

 $MgO(s)+2HCl(aq.\)+H_2O(l)$ will be

A. Greater than $-57.33 K Jmol^{-1}$

B. Less than $-57.33 K Jmol^{-1}$

C. $-57.33 K Jmol^{-1}$

D. $57.33 K Jmol^{-1}$

Answer: D

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19. A reaction occurs spontaneously if:

A. $T\Delta S=\Delta H$ and both ΔH and ΔS are positive

B. $T\Delta S > \Delta H$ and both ΔH and ΔS are positive

C. $T\Delta S > \Delta H$ and both ΔH and ΔS are positive

D. $T\Delta S > \Delta H$ and both ΔH and ΔH is positive and

 ΔS is negative

Answer: A

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20. Which of the following pairs of a chermical reaction is centain to result in a spontaneous reaction ?

A. Exothermic and decreasesing disorder

B. Exothermic and increasesing disorder

C. Exothermic and increasesing disorder

D. Exothermic and decreasesing disorder

Answer: B

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21. Identify the correct statement for change of Gibbs energy for a system (ΔG_{system}) at constant temperature and pressure: A. if $\Delta G_{system}=0$, the system is still moving in a

particular direction

B. if $\Delta G_{system}=~-ve$, the process is not spontaneous

C. if $\Delta G_{system}=~+~ve$, the process is spontaneous

D. if $\Delta G_{system}=0$, the sytem has attained equilibrium

Answer: C



22. The enthalpy and entropy change for the reaction,

 $Br_2(l)+Cl_2(g)
ightarrow 2BrCl(g)$

are $30KJmol^{-1}$ and $105JK^{-1}mol^{-1}$ respectively. The

temperation at which the raction will be in equilibrium is:

A. 450K

 $\mathsf{B.}\,300K$

 $\mathsf{C.}\,285.7K$

 $\mathsf{D.}\ 272K$

Answer: D

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23. Assume each reaction is carried out in an open container.

For which reaction will $\Delta H = \Delta U$?

A.
$$PCl_3(g) o PCl_3(g) + Cl_2(g)$$

B.
$$2CO(g) + O_2(g)
ightarrow 2CO_2(g)$$

 $\mathsf{C}.\, H_2(g) + Br_2(g) \to HBr(g)$

D.
$$C(s)+2H_2O(g)
ightarrow 2H_2(g)+CO_2(g)$$

Answer: C



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

A. -121KJ per mol

B. + 121 KJ per mol

C. + 242KJ per mol

D. -242KJ per mol

Answer: C



25. The enthalpy of hydrogenation of cyclohexene is -119.5KJ. If resonance energy of benzene is $-150.4KJMol^{-1}$, its enthalpy of hydrogenation would be

A. $-269.9 K Jmol^{-1}$

B. $-358.5 K Jmol^{-1}$

 $C. - 508.9 K Jmol^{-1}$

D. $-208.1 K Jmol^{-1}$

Answer: A



26. Identify the correct statement regarding a spontaneous process.

A. Lowering of energy 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: D



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

A. $425 K Jmol^{-1}$

B. $213 K J mol^{-1}$

C. $306 K J mol^{-1}$

D. $180 K J mol^{-1}$

Answer: B



28. Consider the following reactions:

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

$$egin{aligned} \Delta H &= \ = \ -X_1 K j mol^{-1} \ & (ext{ii}) \ H_2(g) + rac{1}{2} O_2(g) o H_2 O(l), \ \Delta H &= \ -X_2 K j mol^{-1} \ & (ext{iii}) \ CO_2(g) + H_2(g) o CO(g) + H_2 O(l) \ , \ & \Delta H &= \ -X_3 K J mol^{-1} \ & (ext{iv}) \ C_2 H_2(g) + rac{5}{2} O_2(g) o 2 CO_2(g) + H_2 O(l) \ , \ & \Delta H &= \ +X_4 K J mol^{-1} \end{aligned}$$

Enthanlpy of formation of $H_2O(l)$ is

A.
$$-x_2KJmol^{-1}$$

B. $+x_3KJmol^{-1}$
C. $-x_4KJmol^{-1}$
D. $+x_1KJmol^{-1}$

Answer: A

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29. Which of the following are not state functions?

(I) q+w

(II)q

(III) w

(IV) H-TS

A. $(II),\,(III)$ and (IV)

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

C. (II) and (III)

 $\mathsf{D.}\left(\mathsf{I}\right)$ and $\left(\mathsf{IV}\right)`$

Answer: A

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30. For the gas phase reaction,

 $PCl_5(g)
ightarrow PCl_3(g) + CL_2(g)$

Which of the following conditions are correct?

A. $\Delta H > 0$ and DeltaSgt0`

B. $\Delta H < 0$ and DeltaSltO`

C. $\Delta H > 0$ and DeltaSgt0`

D. $\Delta=0$ and $\Delta S<0$

Answer: C



31. Bond dissociation enthalpy of H_2 , Cl_2 and HCl are

434,242 and $431 K J mol^{-1}$ respectively. Enthalpy of

formation of HCl is

A. $-245 K Jmol^{-1}$

B. $-63KJmol^{-1}$

C. $245 K Jmol^{-1}$

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

Answer: A



32. For the gas phase reaction

 $PCl_5
ightarrow PCl_3(g) + Cl_2(g)$

which of the following conditions are correct?

A. $\Delta H=0$ and $\Delta S<0$

B. $\Delta H > 0$ and $\Delta S > 0$

C. $\Delta H < 0$ and $\Delta S < 0$

D. $\Delta H > 0$ and $\Delta S < 0$

Answer: D



33. At $27^{\circ}C$ latent heat of fusion of a compound is 2930mol .

Entropy change during fusion is

A. 9.77J/molK

B. 10.77J / molK

C. 9.07J/molK

D. 0.977J/molK

Answer: B

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34. The values of ΔH and ΔS for the reacrtion,

 $C_{ ext{graphite}} + CO_2(g) o 2CO(g)$

are 170KJ and $170JJK^-$ respectively. This reaction will be

spontaneous at

A. 510K

 $\mathsf{B.}\,710K$

 $\mathsf{C}.\,910K$

 $\mathsf{D}.\,1110K$

Answer: A



35. The energy absorbed by each molecule (A_2) of a substance is $4.4 \times 10^{-19} J$ and bond energy per molecule is $4.0 \times 10^{-19} J$. The kinetic energy of the molecule per atom will be

A. $4.0 imes 10^{-20} J$ B. $2.0 imes 10^{-20} J$ C. $2.2 imes 10^{-19} J$ D. $2.0 imes 10^{-19} J$

Answer: D



36. From the following bond energies: H - -H bond energy: $431.37 K Jmol^{-1}$

$$C=C$$
 bond energy: $606.10 K J mol^{-1}$

C--C bond energy: $336.49 K Jmol^{-1}$

C-~-H bond energy: $410.50 K Jmol^{-1}$

Enthalpy for the reaction will be:

$$egin{array}{cccc} H & H & H & H & H \ | & | & | \ C & = & C \ | & | & H & H & H & H \ | & H & H & H & H \end{array}$$

A.
$$553.0 KJmol^{-1}$$

B. 1523.6*KJmol*⁻¹

C.
$$-243.6 K Jmol^{-1}$$

D.
$$-120.0 K Jmol^{-1}$$

Answer: B



37. Three moles of an ideal gas expanded spotaneously into

vacuum. The work done will be

A. Infinite

B. 3 joules

C. 9 joules

D. zero

Answer: D



38. For vaporization of water at 1 atmospheric pressure the

values of ΔH and ΔS are $40.63 K Jmol^{-1}$ and
$108JK^{-1}mol^{-1}$, respectively. The temperature when Gibbs energy change (ΔG) for this transformation will be zero is

A. 273.4K

 $\mathsf{B.}\,393.4K$

C.373.4K

D. 293.4K

Answer: D



39. The following two reactionas are known

 $FeO_3(s)+3CO(g)
ightarrow 2Fe(s)+CO_2(g):$

 $\Delta H = -26.8 KJ$

 $FeO(s)+CO(g)
ightarrow Fe(s)+CO_2(g)\!:\!\Delta H=\ -\ 16.5KJ$

The value of ΔH for the following reaction

 $Fe_2O_3(s)+CO(g)
ightarrow 2FeO_2(s)+CO_2(g)$ is

 $\mathsf{A.}+10.3KJ$

 $\mathsf{B.}-43.3KJ$

C. - 10.3 KJ

 $D.\,6.2KJ$

Answer: C



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

A.
$$q=0, \Delta T < 0, w
eq (=) 0$$

B. $q=0, \Delta T
eq 0, w=0$

C.
$$q
eq 0, \Delta T = 0, w = 0$$

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

Answer: D



41. Enthalpy change for the reaction

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

The dissociation energy of H - H bond is:

A. = 217.4KJ

 $\mathsf{B.}-434.8KJ$

 ${\rm C.}-869.6KJ$

 $\mathsf{D.}+434.8KJ$

Answer: D



A. + 4376

B. + 40.66

 $\mathsf{C.}+37.56$

 $\mathsf{D.}-43.76$

Answer: D



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

A. 5.260 cal/(molK)

 $\mathsf{B.}\, 0.560 cal\,/\,(molK)$

 $\mathsf{C.}\,10.52 cal\,/\,(molK)$

D. 21.04 cal/(molK)

Answer: C



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

$$egin{aligned} \mathsf{A}.\,Mg(s)+rac{1}{2}O_2(g) &
ightarrow MgO(s) \ &\mathsf{B}.\,rac{1}{2}C(ext{graphite})+rac{1}{2}O_2(g) &
ightarrow rac{1}{2}CO_2(g) \ &\mathsf{C}.\,C(ext{graphite})+rac{1}{2}O_2(g)
ightarrow CO(g) \ &\mathsf{D}.\,CO(g)+rac{1}{2}O_2(g)
ightarrow CO_2(g) \end{aligned}$$

Answer: A



45. Equal volumes of two monmoatomic gases, A, B, at the same temperature and pressure are mixed. The ratio of specific heats (C_p/C_v) of the mixture will be

A.0.83

B. 1.50

C. 3.3

 $D.\,1.67$

Answer: C



46. A reaction having equal energies of activation for forward

and reverse reactions has

A. $\Delta G=0$

 $\mathrm{B.}\,\Delta H=0$

C. $\Delta H = \Delta G = \Delta S = 0$

D. $\Delta S=0$

Answer: D

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47. 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 highly

negative.

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

positive.

Answer: B



48. For the reaction:

 $X_2O_4(l)
ightarrow 2XO_2(g)$

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

Hence ΔG is

 ${\rm A.}\ 2.7 K cal$

 ${\rm B.}-2.7 K cal$

 ${\rm C.}\,9.3K cal$

 $\mathsf{D.}-9.3K cal$

Answer: B



49. Given :



The enthalpy of hydrogenation of these compounds will be in

the order as

A. II > III > I

 $\mathsf{B.}\,II>I>III$

 $\mathsf{C}.\,I>II>III$

 $\mathsf{D}.\,III>II>I$

Answer: B



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

 $\mathrm{A.}-630KJ$

 $\mathrm{B.}-3.15KJ$

 ${\rm C.}-315KJ$

D. + 315KJ

Answer: D

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51. 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: C



52. For a given reaction $\Delta H = 35.5 k Jmol^{-1}$ and $\Delta S = 83.6 J K^{-1} mol^{-1}$. The reaction is spontaneous at : (Assume that ΔH and ΔS do no vary with temperature)

A. T>425K

B. All temperatures

 ${\rm C.}\,T>298K$

 $\mathrm{D.}\,T < 425K$

Answer: D



53. The bond dissociation energies of X_2 , Y_2 and XY are in the ratio of $1: 0.5: 1. \Delta H$ for the formation of XY is $-200kJmol^{-1}$. The bond dissociation energy of X_2 will be

A. $200 K J mol^{-1}$

B. 100*KJmol*⁻¹

C. $800 K Jmol^{-1}$

D. $400 K J mol^{-1}$

Answer: A



AIIMS Questions

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

A. Internal energy

B. Enthalpy

C. Work

D. Entropy

Answer: C

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2. Among them intensive property is

A. mass

B. volume

C. surface tension

D. Enthalpy

Answer: C

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

$$CO(G)+rac{1}{2}O_2(g) o CO_2(g),$$

A. ΔH is independent of the physical state of the

reactants of that compound

 $\mathrm{B.}\,\Delta H > \Delta E$

 $\mathsf{C.}\,\Delta H > \Delta E$

D.
$$\Delta H = \Delta E$$

Answer: C



4. For the reaction of one mole of zinc dust with one mole of sulphuric acid in a bomb calorimeter ΔU and w correspond to

A.
$$\Delta U < 0, w = 0$$

B.
$$\Delta U=0, w=0$$

C.
$$\Delta U > 0, w = 0$$

D.
$$\Delta U < 0, w > 0$$

Answer: C



5. Which of the following expressions represent the first law of thermodyanmics?

- A. $\Delta E = -q + W$
- B. $\Delta E = q W$
- C. $\Delta E = q + W$

D.
$$\Delta E = -q - W$$

Answer: A



6. The relation between change in internal energy (ΔE) change in enthalpy (ΔH) and work done (W) is represented

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

B. $W = \Delta E - \Delta H$
C. $\Delta E = W - \Delta H$

D.
$$\Delta E = \Delta H + W$$

Answer: C



7. Work done during isothermal expansion of one mole of an

ideal gas form 10atm to 1atm at 300K is (Gas constant=2)

 ${\rm A.}\,938.8 cal$

 $B.\,1138.8 cal$.

 $\mathsf{C}.\,1381.8 cal$.

 $\mathsf{D}.\,1581.8 cal\,.$

Answer: A

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8. Internal energy is sum of

A. parthly potential and partly Kinetic

B. totally Kinetic

C. totally potential

D. none of these

Answer: C



9. For whichreaction from the following , (ΔS) will be maximum

A.
$$Ca(s)+rac{1}{2}O_2(g) o CaO(s)$$

B. $CaCO_3(s) o CaO(s)+CO_2(g)$
C. $C(s)+O_2(g) o CO_2(g)$
D. $N_2(g)+O_2(g) o 2NO(g)$

Answer: A



10. The occurrence of a reaction of impossible if

A. ΔH is $+ve, \Delta S$ is also +ve but $\Delta H < T\Delta S$

B. ΔH is $-ve, \Delta S$ is also -ve but $\Delta H < T\Delta S$

C. ΔH is $-ve, \Delta S$ is +ve

D. ΔH is $+ve, \Delta S$ is -ve

Answer: B

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11. Which of the followingis true for the reaction

A.
$$\Delta E=0$$

B. $\Delta H=0$
C. $\Delta H=\Delta E$

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

Answer: D



12. Following data is known about melting of a compound AB

.
$$\Delta H = 9.2 k J mol^{-1},$$
 $\Delta S = 0.008 k J K^{-1} mol^{-1}$ Its

melting point is

A. 736K

 $\mathsf{B.}\,1050K$

 $\mathsf{C.}\,1150k$

D. $1150^{\,\circ}\,C$

Answer: D



13. One mole of an ideal gas is allowed to expand reversible and adiabatically from a temperatureof $27^{\circ}C$) if the work done during the process is 3kJ, the final temperature will be equal to $(C_v = 20 J K^{-1})$

A. 150K

 $\mathsf{B.}\,100K$

C. $26.85^{\,\circ}C$

D. 295K

Answer: A



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

A. 1

 $\mathsf{B.}\,2$

 $C.\,1.67$

 $\mathsf{D}.\,1.5$

Answer: A



15. Which of the following has $\Delta S^{\,\circ}$ greater than zero

$$egin{aligned} \mathsf{A}.\,CaO+CO_2(g)&\Leftrightarrow CaCo_3\ && \mathsf{B}.\,NaCl(aq)&\Leftrightarrow NaCl(s)\ && \mathsf{C}.\,NaNO_3(s)&\Leftrightarrow Na^+(aq)+NO_3^-(aq)\ && \mathsf{D}.\,N_2(g)+3H_2(g)&\Leftrightarrow 2NH_3(g) \end{aligned}$$

Answer: D

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16. Which of the following neutralisation reasons, the heat of

neutralisation will be highest?

A. NH_4OH and CH_3COOHH

B. NH_4OH and HCl

C. NaOH and CH_3COOH

D. NaOH and HCl

Answer: C



17. The heat of neutralisation f a strong acid and a strong alkali is $57.0kJmol^{-1}$. The heat released when 0.5 mole of HNO_3 solution is mixed with 0.2 mole fo KOH is

A. 57.0KJ

 $\mathsf{B}.\,11.4KJH$

 $\mathsf{C.}\,28.5KJ$

 $\mathsf{D}.\,34.9KJ$

Answer: D



18. If enthalpies of formation of $C_2H_4(g)1$ and $H_2O(l)$ at $25(\circ)C$ and 1 atm pressure be 52, -394 and $-286kJmol^{-1}$ respectively ,the enthalpy of combustion of $C_2H_4(g)$ will be

A. $1412 K J mol^{-1}$

B. $-1412 K J mol^{-1}$

 $\mathsf{C.} + 141.2 KJmol^{-1}$

D. $-141.2 K J mol^{-1}$

Answer: B

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19. Combustion fo glucose takes place according to the equation,

 $C_6H_{12}O_6+6O_2
ightarrow 6CO_2+6H_2O,$ $\Delta H=-72kcal$ How much energy will be required for the production of 1.6g of glucose (Molecular mass of glucose=180g)

 ${\rm A.}\, 0.064 K cal$

 ${\tt B.}\, 0.64 K cal$

 $\mathsf{C.}\,6.4K cal$

 $\mathsf{D.}\,64K cal$

Answer: B



20. Ozone is prepared by passing silent electric discharge through oxygen. In this reaction

A. energy is given out

B. energy is absorbed

C. oxygen is loaded with energy

D. oxygen is dissociated into atoms

Answer: B

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

A. - 81.98 KJ

 $\mathrm{B.}-819.8KJ$

 ${\rm C.}-40.99KJ$

 $\mathsf{D.}+819.8KJ$

Answer: A



22. Enthalpy of neutralisation of acetic acid by NaOH is -50.6KJ/mol and the heat of neutralisation of a storng acid with a strong bases is -55..9KJ/mol. What is the value of ΔH for the ionisation of CH_3COOH ?

A. +5.3KJ/mol

B.+6.2KJ/mol

 $\mathsf{C.} + 8.2 KJ/mol$

D. + 9.3KJ/mol

Answer: B



23. The enthalpy of combustion of $C_6H_6(l)$ is -3250KJ. When 039g of benzene is burnt excess of oxygen in an open vessel, the amount of heat evolved is

A. 16.25J

 $\mathsf{B}.\,16.25KJ$

 $\mathsf{C.}\,32.5J$

D. 32.5KJ

Answer: A



24. One gram sample of NH_4NO_3 is decomposed in a bomb calorimeter. The temperature of the calorimeter increases by 6.12K. The heat capacity of the system is 1.23KJ/g/deg. What is the molar heat of decomposition for NH_4NO_3 ?

 $\operatorname{A.}-7.53KJ/mol$

 $\mathrm{B.}-398.1 KJ\,/\,mol$

C. - 16.1 KJ/mol

D. - 602 KJ / mol

Answer: B



25. How much energy is released when 6 mole of octane is burnt in air ? Given ΔH_f° for $CO_2(g)$, $H_2O(g)$ and $C_8H_{18}(l)$ respectively are -490, -240 and +160KJ/mol

A. -6.2KJ

 $\mathsf{B.}-37.4KJ$

 ${\rm C.}-35.5KJ$

 $\mathrm{D.}-20.0KJ$

Answer: A



26. In an isobaric process, the ratio of heat supplied to the system (dQ) and work done by the system (dW) for diatomic gas is

A. 1:1

B. 7:2

C.7:5

D. 5:7

Answer: B



27. Sulphur (2.56g) is burend in a constant volume calorimeter with excess $O_2(g)$. The temperature increases from 21.25° to $26.72^{\circ}C$, The bomb has a heat capacity of $923JK^{-1}$. Calorimeter energy contains 815g of water. Thus, change in internal energy per mole of SO_2 formed for the reaction is

 $S_8(s)+8O_2(g)8SO_2(g)$

(specific heat of water is $4.184 J K^{-1} g^{-1}$).

 $\mathsf{A.}-296.27KJ$

 $\mathsf{B.}+296.27KJ$

 $\mathsf{C.}-2370.13KJ$

 $\mathsf{D.}+2370.13KJ$

Answer: B


28. One monoatomic gas is expanded adibatically from 2L to

10L at atm external pressure find ΔU (in atm L)?

A. - 8

 $\mathsf{B.0}$

 $\mathsf{C.}-66.7$

 $D.\,58.2$

Answer: A



29. Which are extensive properties?

A. $V \mbox{ and } E$

 $\operatorname{B.} V \operatorname{and} T$

C. V and C_p

D. \boldsymbol{P} and \boldsymbol{T}

Answer: A

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Assertion - Reasoning Questions

 Assertion: Absolute values of intenal energy of substances cannot be determined.
 Reason: It is impossible to determine exact values of

constituent energies of the substances.

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



2. Assertion:The increase in internal energy (ΔE) for the vaporiation of one mole of water at 1atmand 373K is zero. Reason: For all isothermal processes $\Delta T = 0$

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



3. Assertion: The enthalpies of neutralised of strong acids and

strong bases are always same.

Reason:Neutralisation is heat of formation of water.

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



4. Assertion: Phase transition involves change in internal energy only.

Reason:Phase transition occurs at constant pressure.

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



5. Assertion:The SIunit of entropy is $JK^{-1}mol^{-1}$

Reason: $\Delta S = rac{q_{rev}}{T}$

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: D



6. Assertion:The change in entropy during melting of ice is negligible in comparison to change in entropy during vaporisation.

Reason:The volume occupied by solid and liquids is too less in comparison to volume occupied by gas.

A. If both ther assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



7. Assertion:Spontaneous process is an irreversible process and may be reversed by some external agency.
Reason:Decrease in enthalpy is a conrtributory factor for spontaneity.

A. If both ther assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: A



1. Calcualte the maximum efficiency of an engine operating between $110^{\circ} C$ and $25^{\circ} C$.

A. 11.1 %

B. 22.2 %

C. 33.3 %

D. 44.4 %

Answer: B



2. Five moles of anideal gas expends reversily from a volume of $8dm^3$ at a temperature of $27^{\circ}C$ Calculate the change in entropy.

A. $70.26 JK^{-1}$

B. $82.55 JK^{-1}$

C. $95.73 JK^{-1}$

D. $107.11 JK^{-1}$

Answer: B



3. Entropy change involve in conversion of 1 mole of liquid water at 373K to vapour at the same temperature (latent

heat of vaporisation of water= $2.257kJg^{-1}$)

A.
$$30.7 J K^{-1} mol^{-1}$$

B. $60.3 J K^{-1} mol^{-1}$

C. $90.8 J K^{-1} mol^{-1}$

D. $108.9 J K^{-1} mol^{-1}$

Answer: C



4. What is the value of ΔE (heat change at constant volume) for reversible isothermal evaporation of 90g water at $100^{\circ}C$ Assuming water vapour behaves as an ideal gas and $(\Delta H_{\rm vap})_{\rm water} = 540 calg^{-1}$

A. $9 imes 10^3 cal$

B. $6 imes 10^3 cal$

 $\mathsf{C.}\,4.49 cal$

D. none of these

Answer: D

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5. Which of the statement is correct?

A. Slope of adiabatic P-V curve will be the same as that

of isothermal one.

B. Slope of adiabatic P - V curve is smalller than that of

isothermal one.

C. Slope of adiabatic P - V curve is larger than that in

isothermal one.

D. Slope of adiabatic P-V curve may be smaller or

larger depending on the value V.

Answer: D



6. The specific heats of iodine vapour and solid are 0.031 and 0.055cal/g respectively. If heat of sublimation of iodinde is 24cal/g at $200^{\circ}C$, what is its value at $250^{\circ}C$?

A. 5.7 calg $^{-1}$

B. 11.4*calg*⁻¹

C. $22.8 calg^{-1}$

D. $45.6 calg^{-1}$

Answer: C

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7. Bond dissociation energy of $CH_3 - H$ bond is $103Kcalmol^{-1}$ and 0.055cal/g respectively , If specific heat of iodine is 24cal/g at 200° , Calcualte its value at $250^{\circ}C$ is

A. $3.61 K calmol^{-1}$

B. $-3.61 K calmol^{-1}$

C. $33.61 K calmol^{-1}$

D. $-33.61 K calmol^{-1}$

Answer: C



8. Given,
$$H_s(g)=2H(g)\Delta_{H-H}=103kcalmol^{-1}$$
 $CH_4(g)=CH_3(g)+H(g)\Delta_{CH_3-H}=103kcalmol^{-1}$

The heat of reaction of

$$CH_4(g) = CH_3(g) + H(g)$$

A. $103K calmol^{-1}$

B. $206 K calmol^{-1}$

C. 51.5

D. zero

Answer: C



9. For the combustion of n-octane

 $C_8 H_{18} + O_2
ightarrow CO_2 + H_2 O$ at $25^\circ C$ (ingnoring resonance in CO_2)

A. $\Delta H = \Delta E - 5.5 imes 8.31 imes 0.298 \in \mathit{KJ}\,/\mathit{mol}$

B. $\Delta H = \Delta E - 4.5 imes 8.31 imes 0.298 \in KJ \,/ \,mol$

C. $\Delta H = \Delta E - 4.5 imes 8.31 imes 0.298 \in KJ \,/ \,mol$

D. $\Delta H = \Delta E - 4.5 imes 8.31 imes 0.298 \in \mathit{KJ}\,/\mathit{mol}$

Answer: D

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10. The enthapies of neutralisation of $HClO_4$ and $Cl_3C-COOH$ are

-13.5kcal/g-equivalent and

-13...5kcal/g - equivalent respectively

When 40g of solid NaOH is added to a mixture of $1gmolHClO_4$ and $1gmolCl_3C - COOH$, sodium perchlorate and sodium trichloeoacetate are formed in molar ratio of 3:1 Then.

- A. ΔH for the reaction of NaOH is added to a mixture is 6.45 K cal .
- B. ΔH for the reaction of NaOH is added to a mixture s13.8Kcal .

C. After reaction the total no. of moles of acid remained

 $0.5(HCIO_4 + Cl_3Cl - COOH)$

D. After reaction the total weight of acid remained

 $147.75g(HCIO_4 + Cl - COOH)$

and ΔH for the reaction of NaOH with mixture is

-13.8 K cal.

Answer: C

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11. The work done in erge for the reversible expansion of 1

mole of an ideal gas from a volume of 10 litres to 20 litres at

 $25^{\,\circ}\,C$ is

A. $2.303 imes 298 imes 0.082 \log 2$

 $\text{B.}-298\times10^7\times8.31\times2.303\log2$

C. $2.303 imes 298 imes 0.082 \log 0.5$

D. $2.303 imes 298 imes 2\log 2$

Answer: D

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

A. 43.4J/mol

 $\mathsf{B.}\,87.2J\,/\,mol$

C. 900J/mol

D. Zero

Answer: B

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

 $\mathsf{A.}+229.70KJ$

 $\mathrm{B.}-229.70KJ$

 ${\rm C.}+226.70KJ$

 $\mathsf{D.}-22.670KJ$

Answer: A



14. One gram sample of NH_4NO_3 is decomposed in a bomb calorimeter. The temperature of the calorimeter increases by 6.12K. The heat capacity of the system is 1.23KJ/g/deg. What is the molar heat of decomposition for NH_4NO_3 ?

A. -7.53KJ/mol

B. 398KJ/mol

 $\mathsf{C.}-16.1KJ/mol$

D. - 602 KJ / mol

Answer: B



15. Calculate the resonance enegry of N_2O form the following data

 $\Delta_{f} H^{\,\Theta} of N_{2} O = 82 k Jmol^{-1}$

Bond energy of $N \equiv N, N = N, O = O$, and N = O bond

is 946, 418, 498, and $607 k Jmol^{-1}$, respectively.

A. $-88KJmol^{-1}$

B. $-44KJmol^{-1}$

C. $-22KJmol^{-1}$

D. None of these

Answer: A



16. If a 298K the bond energies of C - H, C - C, C = Cand H - H bonds are respectivly 414, 347, $615KJmol^{-1}$, the value of enthalpy change for the reaction $H_2C = CH_2(g) + H_2(g) + H_2(g) \rightarrow H_3C - CH_3(g)$ at 298K will be

 $\mathsf{A.}+250KJ$

 $\mathrm{B.}-250KJ$

 ${\rm C.}+125KJ$

 $\mathsf{D.}-125KJ$

Answer: B

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17. The enthalpies of formation of Al_2O_3 and Cr_2O_3 are -1596KJ and -1134KJ respectively. ΔH for the reaction $2Al+Cr_2O_2 o 2Cr+Al_2O_3$ is

 $\mathrm{A.}-2730KJ$

 $\mathrm{B.}-462KJ$

 ${\rm C.}-1365KJ$

D. + 2730KJ

Answer: B



18. "The quanity of heat which must be supplied to decompose a compound into its element is equal to the heat

evolved durring the formation of that compound from the element. " This statement is known as

A. Hess's law

B. Joule's law

C. Le-Chatelier's principle

D. Lavoisier and Laplace law

Answer: B

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19.
$$C_{ ext{graphite}} + O_2(g) o CO_2(g)$$

 $\delta H=~-~94.05 K calmol^{-1}$

`C_("diamond")+O_(2)(g),DeltaH=-94.50Kcalmol^(-1)

Therefore,

A.
$$C_{ ext{graphite}} o C_{ ext{diamond}}, \Delta H_{298K^\circ = -450 calmol^{-1}}$$

$$\mathsf{B.}\ C_{\mathrm{diamond}} \rightarrow C_{\mathrm{graphite}}, \Delta H_{298K^\circ\,=\,+\,450 calmol^{\,-\,1}}$$

C. Graphite is the stabler allotrope

D. Diamond is harder than graphite

Answer: D



20. Which of the follwing has lowest fusion temperature ?

A. Naphthalene

B. Diamond

 $\mathsf{C.}\, NaCl$

 $\mathsf{D}.\,Mn$

Answer: C

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21. Given the bond energies N = N, H - H and N - Hbonds are 945, 436 and $391 K Jmol^{-1}$ respectively, the enthalpy of the following reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is

 $\mathsf{A.}-93KJ$

 $\mathsf{B.}\ 102KJ$

 $\mathsf{C}.\,90KJ$

 $\mathsf{D}.\,105KJ$

Answer: A

22. For conversion C (graphite) ightarrow C (diamond) the ΔS is

A. Zero

B. Positive

C. Negative

D. Unknown

Answer: A



23. Smelting of iron ore takes place through this reaction

 $2Fe_2O_3(s)+3C(s)
ightarrow 4Fe(s)+3CO_2(g)$

 ΔH_f^2 of Fe_2O_3 and CO_2 are $-8242KJmol^{-1}$ and $-393.7KJmol^{-1}$

The reaction is

A. Endothermic

B. Exothermic

 $\mathsf{C.}\,\Delta H=0$

D. None of these

Answer: A

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24. For the given heat of reaction,

(i) $C(s) + O_2(g)CO_2(g) + 97Kcal$

(ii) $CO_2(g) + C(s) = 2CO(g) - 39Kcal$

the heat of combustion of CO(g) is:

A. 68Kcal

 ${\sf B.}-68 K cal$

C. + 489 K cal

D. None

Answer: B



25. What is the amount of heat to be supplied to prepare 128g of $CaCO_3$ by using $CaCO_3$ and followed by reduction with carbon, Reactions are

 $egin{aligned} CaCO_3(s) &= CaO(s) + CO_2(g), \Delta H^\circ = 42.8 K cal \ CaCO(s) &= 3C(s) = CaC_2 + CO(g), \Delta H^\circ = 111 K cal \end{aligned}$

 $\textbf{A.}\ 102.6 K cal$

 $\mathsf{B.}\,221.78K cal$

 $\mathsf{C.}\,307.6K cal$

 $\mathsf{D.}\,453.46K cal$

Answer: A



26. Ionisation energy of $A1 = 5137 K Jmol^{-1}(\Delta H)$ hydration of $Al^{3+} = -4665 K Jmol^{-1}$. $(\Delta H)_{hydration}$ for $Cl^{-} = -381 K Jmol^{-1}$. Which of the following statement is correct?

A. $AlCl_3$ would remauin covalent in aqueous solution

B. Only at infinite dilution $AlCl_3$ undergoes ionisation

C. In aqueous solution $AlCl_3$ becomes ionic

D. Nonee of these

Answer: C

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27. At $0\,{}^\circ C$, ice and water are in reuilibrium and ΔS and ΔG

for the conversion of ice to liquid water is

A. 0, $21.98 JK^{-1} mol^{-1}$

 $\mathsf{B.}-ve$, zero

C. -ve, $21.98JK^{-1}mol^{-1}$

D. Zero, zero

Answer: C



28. Assertion : Molar entropy of vaporization of water is different from ethanol.

Reason : Water is more polar than ethanol.

A. If both the assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explanation of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: B

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29. Assertion: The increase in internal energy (ΔE) for the vaporisation of 1 mole of water at 1 atm and 373K is zero. Reason: For all isothermal processes $\Delta E = 0$.

A. If both ther assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.

D. If assertion is false but reason is true.

Answer: B



30. Assertion: The enthalpies of neutralisation of strong acids and strong bases are always same.

Reason: Neutralisation is heat of formation of water.

A. If both ther assertion and reason are true and the

reason is the correct explanation of the assertion.

B. If both the assertion and reason are true but reason is

not the correct explantion of the assertion.

C. If the assertion is true but reason is false.
D. If assertion is false but reason is true.

Answer: A



1. Calculate the entropy change when 3.6g of liquid water is completely converted into vapour at $100^{\circ}C$. The molar heat of vaporization is $40.85 K Jmol^{-1}$.

A. $6.08 JK^{-1}$

B. 109.5*JK*⁻¹

C. $21.89 JK^{-1}$

D.
$$-21.89 JK^{-1}$$

Answer: C



2. In an irreversible process taking place at constant P and T in which only pressure volume work is being done by the system the change in Gibb's energy (ΔG) and change in entropy (Δ) , satisfy the criterion:

$$\begin{array}{l} \mathsf{A}.\ (\Delta S)_{V.U} = 0,\ (\Delta G)_{T.P} = 0\\\\ \mathsf{B}.\ (\Delta S)_{V.U} = 0,\ (\Delta G)_{T.P} = \ + \ ve\\\\ \mathsf{C}.\ (\Delta S)_{V.U} = 0,\ (\Delta G)_{T.P} = \ - \ ve\\\\ \mathsf{D}.\ (\Delta S)_{V.U} = 0,\ (\Delta G)_{T.P} = \ - \ ve\end{array}$$

Answer: C

3. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K_c is:

A. $\Delta G^\circ = RT \ln K_C$

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B. $-\Delta G^\circ = RT \ln K_C$

C. $\Delta G = RT \ln K_C$

D. $-\Delta G = RT \ln K_C$

Answer: D



4. Predict which of the following reaction (s) has a positive entropy change?

 $I \,.\, Ag^+(aq) + Cl^-(aq) o AgCl(s)$

 $II \,.\, NH_4Cl(s)
ightarrow NH_3(g) + HCl(g)$

III . $2NH_3(g)
ightarrow N_2 + 3H_2(g)$

A. I and II

B. III

C. II and III

D. II

Answer: B

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5. Maxing of non-reacting gases is generally accompanied by

A. `Decreases in enthropy

B. Increases in entropy

C. Change in enthalpy

D. Change in free energy

Answer: C



6. A particular state of system is arrived at starting from a given state in two different ways (1) following reversible path and (2) irreversible path. Which of the following relations would be correct if the processes are isothermal ?

A.
$$\Delta S_{rev}
eq \Delta S_{irrev}$$

B.
$$\Delta q_{rev} = \Delta q_{irrev}$$

C.
$$\Delta S_{rev} = \Delta S_{irrev} = rac{\Delta q_{rev}}{T}$$

D.
$$\Delta S_{irrev} = rac{\Delta q_{irrev}}{T}
eq \Delta S_{rev}$$

Answer: B



7. For a spontaneous reaction, ΔG , equilibrium constant (K)

and E^0_{cell} will be respectively :

A.
$$-ve, > 1, +ve$$

 $\mathsf{B.} + ve, > 1, -ve$

 $\mathsf{C}.-ve,\ <1,\ -ve$

$$\mathsf{D}.-ve, > 1, -ve$$

Answer: A



8. For the water gas reaction $C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$ At 1000K, the standard Gibbs free energy change of the reaction is -8.314KJ/mol. Therefore, at 1000K the

equilibrium constant of the above water gas reaction is

A. 1

B. 10

C.
$$\frac{1}{e}$$

D. 2.718

Answer: A

9. At
$$500K$$
, for an isobaric pracess.

$$\Delta S_{system} = -10 \frac{KJ}{molK} \text{ and } \Delta S_{surr} = 12 \frac{KJ}{molK}$$
Therefore, ΔG for the entire process is

A. -500 KJ/mol

- $\mathrm{B.}-1000 KJ/mol$
- ${\rm C.}-600 KJ/mol$
- $\mathrm{D.}-1100 KJ/mol$

Answer: D



10. Identify the correct statement regarding a spontaneous process:

A. For a spontaneous process in an isolated system, the

change in entropy is positive

- B. Endothermic process are never spontaneous
- C. Exothermic processes are always spontaneous
- D. Lowering of energy in the reaction process is the only

criterion for spontaneity

Answer: B



11. Standard entropt of X_2 , Y_2 and XY_3 are 60, 40 and $50JK^{-1}mol^{-1}$, respectively. For the reaction, $rac{1}{2}X_2+rac{3}{2}Y_2 o XY_3, \Delta H=-30KJ$, to be at

equilibrium, the temperature will be:

A. 1250K

 $\mathsf{B.}\,500K$

 $\mathsf{C.}\,750K$

 $\mathsf{D.}\,1000K$

Answer: A



12. If liquids A and B from an ideal solution,

A. The entropy of mixing is zero

B. The Gibbs free energy as well as the entropy of mixing

are zero

C. The Gibbs free energy as well as the enthalpy of mixing

are zero

D. The enthalpy of mixing is zero

Answer: C



13. Which reaction, with the following value of ΔH and ΔS

at 350K is spontaneous and endothermic?

 $\Delta HKJmol^{-1}\Delta SKJmol^{-1}\Delta HKJmol^{-1}\Delta SKJmol^{-1}$

A. $-48, \ +135 imes 10^{-3}$

B. - 48, -135

 ${\rm C.+48,\ +135\times 10^{-3}}$

D. +48, -135×10^{-3}

Answer: D

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14. The incorrect expression among the following is

A.
$$rac{\Delta G_{
m system}}{\Delta G_{
m total}} = - T$$

B. in isothermal process, $W_{
m reversible} = -nRT {
m in} rac{V_f}{V_i}$

C. In
$$K=rac{\Delta H-T\Delta S^{\,\circ}}{RT}$$

D. $K=e^{-\,\Delta G^{\,\circ}\,/\,RT}$

Answer: C



15. Which of the following reactions is associated with the most negative change in entropy?

A.
$$2SO_2(g)+O_2(g)
ightarrow 2SO_3(g)$$

B.
$$C_2H_4(g)+H_2(g)
ightarrow C_3H_6(g)$$

$$\mathsf{C}.\, C(s, \hspace{0.2cm} ext{graphite}) + O_2 o CO_2(g)$$

D. $3C_2H_2(g)
ightarrow C_6H_6(g)$

Answer: C



16. For the reaction in the plant cells

 $\begin{array}{l} 6CO_2(g)+12H_2O(l)
ightarrow C_6H_{12}O_6(s)+6O_2(g)\ +6H_2O(l)\Delta_rG^0=3000KJ/mol\ ATP
ightarrow ADP+PO_4^{3-}\Delta_rG^0=-30KJ/mol\ Glucose\ is\ stored\ in\ the\ plant\ cell\ as\ starch\ (C_6H_{10}O_5)_n\ .\ To\ produce\ 162g\ of\ starch\ how\ many\ moles\ of\ ATP\ are\ minimum\ required? \end{array}$

A. 100mol

B. 10mol

C. 20mol

 $\mathsf{D.}\ 200 mol$

Answer: D



17. 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 $27^\circ C$ is

A. $38.3 JK^{-1}$

B. 35.8*JK*⁻¹

C. $32.3 J K^{-1}$

D. $42.3 JK^{-1}$

Answer: A



18. In view of the signs of $\Delta_r G^0$ for the following reactions

 $PbO_2+Pb
ightarrow 2PbO, \Delta_r G^0 < 0$

 $SnO_2+Sn
ightarrow 2SnO, \Delta_r G^0>0$

Which oxidation state are more characteristic for lead and tin?

A. For lead +4 , for tin +2

B. For lead +2 , for tin +2

C. For lead +4 , for tin +4

D. For lead +2 , for tin +4

Answer: A

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19. Two moles of an ideal gas is expanded irreversibly and isothermally at $37^{\circ}C$ until its volume is doubled and 3.41KJ

heat is absorbed from surrounding. P $\Delta S_{
m total}$ (system +surrounding) is:

A. -0.52 J/K

 $\operatorname{B.} 0.52 J/K$

C. 22.52J/K

 $\mathsf{D}.0$

Answer: B

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20. A spontaneous change is one in which a system under

goes

A. an increases in internal energy

B. a lowering of entropy

C. a lowering of free energy

D. no energy change

Answer: B

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21.
$$C_2H_6(g)+3.5)_2(g) o 2CO_2(g)+3H_2O(g)$$

 $\Delta S_{vap}(H_2O,l)=x_1calK^{-1}$ (boiling point $=T_1$)
 $\Delta H_f(H_2O,l)=x_2$
 $\Delta H_f(CO_2)=x_3$
 $\Delta H_f(C_2H_6)=x_4$
Hence, ΔH for the reaction is

A.
$$2x_3+3x_2-x_4$$

B. $2x_3 + 3x_2 - x_4 + 3x_1T_1$

C.
$$2x + 3x_2 - x_4 + 3x_1T_1$$

D.
$$x_1T_1+x_2+x_3-x_4$$

Answer: C



22. When reaction is at standard state at equilibrium, then

A.
$$\Delta H^{\,\circ}\,=0$$

B. $\Delta S^{\,\circ}\,=0$

C. equilibrium constant K=0

D. equilibrium constant K = 1

Answer: B

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23. A spontaneous change is one in which a system under goes

A. $T_e > T$

 $\mathsf{B}.\,T>T_e$

C. $T_e \ {\rm is} \ 5 \ {\rm times} \ T$

D. $T = T_e$

Answer: D



24. When reaction is at standard state at equilibrium, then

A. 80~%

 $\mathbf{B.\,87~\%}$

 $\mathsf{C}.\,90\,\%$

D. 97~%

Answer: B

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25. For a spontaneous chemical process, the free energy change is

A. positive

B. negative

C. either positive or negative

D. zero

Answer: D

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26. A reaction has $\Delta H = -33KJ$ and $\Delta S = -58\frac{J}{H}$. This reaction would be:

A. spontanceous at all temperatures

B. non-spontaneous at all temperatures

C. spontaneous above a certain temperature

D. spontaneous below a certain temperature

Answer: B

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27. Which of the following statement (s) is/are correct? Statement (i) : The entropy of isolated system with P - Vwork only is always maximized at euilibrium. Stetement (ii) : It is possible for the entropy of close system to decreases substantilly in an irreversible process. Statement (iii) : Entropy can be created but not be destroyed.

Statement $(iv): \Delta S$ system is zero for reversible process in an isolated system.

A. Statements I, ii, iii ,

B. Statement *ii*, *iv*

C. Statement I, ii, iv

D. All of these

Answer: D

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28. The process of evaporation of a liquid is accompanied by

A. an increases in entropy

B. a decreases in entropy

C. no change in entropy

D. no change in free energy

Answer: D



29. During winters, moisture condenses in the from of dew and can be seen on plant leaves and grass. The entropy of the system in such cases decreases as liquids process lesser disorder as compared to gases. With reference to the second law, which statement is correct. for the above process?

A. The randomness of the universe decreases

- B. The randomness of the surroundings decreases
- C. Increases in randomness of surrroundings equals ito

the decreases in randomness of system

D. The increases in randomness of the surroundings is greater as compared to the decreases in randomness

of the system.

Answer: A

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30. Combustion of sucrose is used by aerobic oranisms for providing energy for the life sustaining processes. If all the capturing of energy from reaction is done through electrical process (non P - V work), then calculate maximum available energy which can be captured by combustion of 34.2g of sucrose.

Given, $\Delta H_{
m combustion}(
m surrose)=~-~6000 K Jmol^{-1}$

 $\Delta S_{
m combustion} = 180 J/K - mol$ and body temperatuire is 300 K

A. 600KJ

B. 594.6KJ

 $\mathsf{C.}\,5.4KJ$

 $\mathsf{D.}\,605.4KJ$

Answer: D

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31. At $0\,^\circ C$, ice and water are in equilibrium and ΔS and ΔG for the conversion of ice to liquid water is

A. 0, $21.98 J K^{-1} mol^{-1}$

 $\mathsf{B.}-ve$, zero

 $C. + ve, 21.98 JK k^{-1} mol^{-1}$

D. All of these

Answer: D

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

- A. $\Delta H < 0, \Delta S > 0$
- B. $\Delta H < 0, \Delta S < 0$
- C. $\Delta H > 0, \Delta S > 0$
- D. None of these

Answer: C



33. When a bottle of perfume is opened, odorous molecules mix with air and slowly diffuse throughout the entire room. Which is not correct for this process?

A. $\Delta G < 0$ B. $\Delta S > 0$ C. $\Delta s H pprox 0$ D. $\Delta S < 0$

Answer: A



34. Change in entropy is negative for

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

$$\mathsf{B}.\, C(s) + H_2O(g) \to CO(g) + H_2(g)$$

 $\mathsf{C}.\, N_2(g,10atm) \to N_2(g,1atm)$

D. $Fe(1mol, 400K) \rightarrow Fe(1mol, 300K)$

Answer: B



35. In which of the following reactions ΔS is positive?

A.
$$H_2O(l) o H_2 + O(s)$$

B. $3O_2
ightarrow 2O_3(g)$

 $\mathsf{C}.\, H_2O(l) \to H_2O(g)$

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

Answer: D

36. The molar enthlpy of fusion of water is $6.01 K J mol^{-1}$. The entropy change of 1 mol of water at its melting point will be

A. $22 Jmol^{-1}K^{-1}$

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- B. $109 Jmol^{-1}K^{-1}$
- C. $44 Jmol^{-1}K^{-1}$

D. spontaneous below a certain temperature

Answer: A

37. When ice melts into water, entropy

A. Becomes zero

B. Decreases

C. Increases in randomness of surrroundings equals ito

the decreases in randomness of system

D. Remains same

Answer: A



38. The value of free energy change of an equilibrium process

A. positive

B. Negative

C. Zero

D. Not definite

Answer: C

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

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

B. $-9.78 JK^{-1}$ mol^(-1)`

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

D. Zero

Answer: C

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40. One mole of an ideal gas at $25^{\circ}C$ is subjected to expand reversible ten times of its intial volume. The change in entropy of expansion is

A.
$$19.15 JK^{-1} mol^{-1}$$

- B. $16.15 JK^{-1} mol^{-1}$
- C. $22.15 JK^{-1}mol^{-1}$

D. None

Answer: A



41. The entropy change for the reaction given below is $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ is ... At 300K . Standard entropies of $H_2(g), O_2(g)$ and $H_2O(l)$ are 126.6, 201.20 and $68.0JK^{-1}mol^{-1}$ respectively.

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

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

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

D. None of these

Answer: A



42. The a reaction to be spontaneous at all temperature

A. ΔG and ΔH should be negative

B. ΔG for the reaction is zero

C. ΔG and ΔH should be positive

D. $\Delta H < \Delta G$

Answer: A



43. Which of the following statements is true? The entropy of

the universe
A. Increases and moves towards maximumm value

B. Decreases and moves to zero

C. Remains constant

D. Decreases and increases with a periodic rrate

Answer: A

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44. Enthalpy of fusion of a liquid is $1.435Kcalmol^{-1}$ and molar entropy change is $5.26calmol^{-1}K^{-1}$ Hence melting point of liquid is

A. $100^{\,\circ}\,C$

 $\mathsf{C.}\,373K$

D. $-273^{\,\circ}C$

Answer: A

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45. If S° for H_2, Cl_2 and HCL are 0.13, 0.22 and $0.19KJK^{-1}mol^{-1}$ respectively. The total change in standard entropy for the reaction $H_2 + Cl_2 \rightarrow 2HCl$ is

A. $0.5KJK^{-1}mol^{-1}$

B. $40JK^{-1}mol^{-1}$

C. $60JK^{-1}mol^{-1}$

D. $20JK^{-1}mol^{-1}$

Answer: B



46. If the enthalpy of vaporization for water is $198.5 K Jmol^{-1}$, the entropy of its vaprization will be

A. $0.5 KJ^{-1}$

- B. $1.0KJK^{-1}mol^{-1}$
- C. $1.5KJK^{-1}mol^{-1}$
- D. $2.0KJK^{-1}mol^{-1}$

Answer: A



47. In the following Table, which one is correct

$\Delta H \Delta S$ Nature of reaction

A. (-)(+) Spontaneous only at high temperature

- B. (+)() Spontaneous regardless of temperature
- C. (+)(+) Spontaneous only at low temperature
- D. (-)(-) Spontaneous at all temperature

Answer: A

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48. For the reaction,

 $X_2O_4(l)
ightarrow 2XO_2(g), \Delta E=2.1 K cal$,

 $\Delta S = 20 cal \, / \, K$ at 300 K . Hence ΔG is

 ${\rm A.}\ 2.7 K cal$

 ${\rm B.}-2.7 K cal$

 ${\sf C}.\,9.3K cal$

 $\mathsf{D.}-9.3K cal$

Answer: B

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49. The temperature at which the reaction,

 $Ag_2O(s)
ightarrow 2Ag(s) + 1/2O_2(g)$

Is at equilibrium is ..., Given $\Delta H = 30.5 K Jmol^{-1}$ and ΔS

 $= 0.066 K J K^{-1}$

A. 462.12K

 $\mathsf{B}.\,362.12K$

 $\mathsf{C.}\ 262.12K$

 $\mathsf{D}.\,562.12K$

Answer: B

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50. Given

(I)

C(diamond)

+

 $+ O_2(g) o CO_2(g), \Delta H^{\,\circ} = \, - \, 92.0 K calmol^{\,-1}$

(II) C(graphite)

 $O_2(g)
ightarrow CO_2(g), \Delta H^{\,\circ} \ = \ -\ 96.0 K calmol^{\,-1}$

A. $2.907 K cal K^{-1}$

B. $2.013 K cal K^{-1}$

C. $305.4 cal K^{-1}$

D. $-2.013KcalK^{-1}$

Answer: A



51. For a certain reaction XrarrY the value of ΔH and ΔS are $50.50 K J mol^{-1}$ and $100.03 J K^{-1}$ respectively. The temperature at which $\Delta G = 0$ is

A. $505^{\,\circ}\,C$

B. $232^{\,\circ}\,C$

C. $252^{\circ}C$

D. $450^{\,\circ}\,C$

Answer: A



52. Which of the following processes process towards more disordered state?

I Stretching the rubberII. Sublimation of dry ice *III* Crystallisation of salt from solution

 ${\it IV}$. Dissolution of sugar from solution

A. I, II, IV

 $\mathsf{B}.\,I,III$

 $\mathsf{C}.\,III,\,IV$

D. II, IV

Answer: B

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