CHEMISTRY

BOOKS - MTG CHEMISTRY (HINGLISH)

THERMODYNAMICS

Thermodynamic Terms

1. The system in which there is no exchange of matter, work, or energy from the surroundings is

A. closed

B. adiabatic

C. isolated

D. isothermal.

Answer: C

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

A. isothermal

B. adiabatic

C. thermal

D. isochoric

Answer: B

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3. $\Delta U = q + w$, is mathematical expression for

A. first law of thermodynamics

B. second law of thermodynamics

C. third law of thermodynamics

D. zeroth law of thermodynamics

Answer: A

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Applications

1. The work done during the expanision of a gas from a volume of $4dm^3$ to $6dm^3$ against a constant external pressure of 3 atm is (1 L atm = 101.32 J)

A. $-6J$

B. $-608J$

C. $+304J$

D. $-304J$

Answer: B

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2. What will be the work done when one mole of a gas expands isothermally from 15 L to 50 L against a constant pressure of 1 atm at $25^{\circ}C$?

A. $-3542cal$

B. $-843.3cal$

C. $-718cal$

D. $-60.23cal$

Answer: C

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3. What is the work done when 1 mole of a gas expands isothermally from 25 L to 250 L at a constant pressure of 1 atm and a temperature of 300 K ?

A. $-3542J$

B. $-5744J$

C. $-2657J$

D. $-4890J$

Answer: B

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4. In thermodynamics, a process is called reversible when

A. surrounding and system change are same

B. there is no boundary between system and surrounding

C. surrounding is always in equilibrium with system

D. system change into surrounding spontaneously:

Answer: C

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5. For an isothermal reversible expansion process, the value of q can be calculated by the expressin

A. $q = 2.30nRT\log.\frac{V_2}{V_1}$

B. $q = -2.303nRT\log.\frac{V_2}{V_1}$

C. $q = -2.303nRT\log.\frac{V_1}{V_2}$

D. $q = -P_{\exp}nRT\log.\frac{V_1}{V_2}$

Answer: A

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6. In an adiabatic expansion of an ideal gas -

A. $W - \Delta U$

B. $W = \Delta U$

C. $\Delta U = 0$

D. $W = 0$

Answer: B

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

A. 10 J, 10 J

B. 8 J, 10 J

C. 18 J, 0 J

D. 0 J, 0 J

Answer: D

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8. If the heat change at constant volume for decomposition of silver oxide is 80.25 kJ, what will be the heat change at constant pressure ?

A. 80.25 kJ

B. gt 80.25kJ

C. lt 80.25 kJ

D. 160.50 kJ

Answer: B

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9. The enthalpy change of a reaction does not depend upon

A. state of reactants bad products

B. nature of reactants and products

C. different intermediate reaction

D. initial and final enthalpy change of a reaction.

Answer: C

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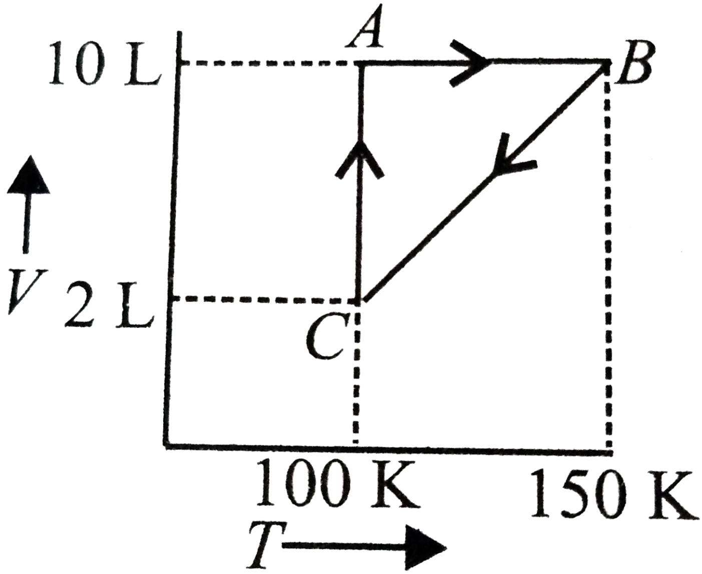
10. Consider the given diagram for 1 mole of a gas X and answer the following question.



The process $A \rightarrow B$ represents

A. isobaric change

B. isothermal change

C. adiabatic change

D. isochoric change.

Answer: D

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11. Which of the following relationships is not correct for the relation between ΔH and ΔU?

A. When $\Delta n_g = 0$ then $\Delta H = \Delta U$

B. When $\Delta n_g > 0$ then $\Delta H > \Delta U$

C. When $\Delta n_g < 0$ then $\Delta U < \Delta U$

D. When $\Delta n_g RT = 0$ then $\Delta H = \Delta U$

Answer: D

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12. Two reactions are given below :

(i) $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$

(ii) $Ag_2O_{(s)} \rightarrow 2Ag_{(s)} + \frac{1}{2}O_{2(g)}$

Which of the following statements is true ?

A. For (i) $\Delta H < \Delta U$ and for (ii) $\Delta H > \Delta U$

B. For (i) $\Delta H > \Delta U$ and for (ii) $\Delta H < \Delta U$

C. For both (i) and (ii) $\Delta H > \Delta U$

D. For both (i) and (ii) $\Delta H < \Delta U$

Answer: A

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13. Consider the following reaction :

$$CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$$

How are ΔU and ΔH related for the reaction ?

A. $\Delta H = \Delta aU - 0.5RT$

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

C. $\Delta H = \Delta U + 0.5RT$

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

Answer: A

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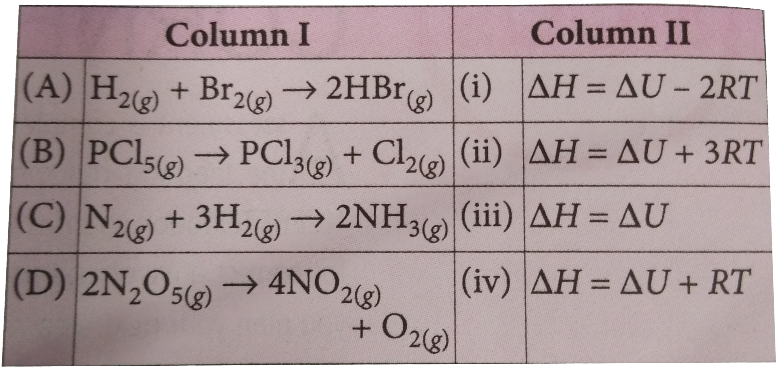
14. Match the column I with column II and mark the appropriate choice.



Column I		Column II	
(A)	$H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$	(i)	$\Delta H = \Delta U - 2RT$
(B)	$PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$	(ii)	$\Delta H = \Delta U + 3RT$
(C)	$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$	(iii)	$\Delta H = \Delta U$
(D)	$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$	(iv)	$\Delta H = \Delta U + RT$

A. (A $\rightarrow$ (iii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (iv)

B. (A) $\rightarrow$ (iii), (B) $\rightarrow$ (iv), (C) $\rightarrow$ (i), (D) $\rightarrow$ (ii)

C. (A) $\rightarrow$ (ii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (iv) (D) $\rightarrow$ (iii)

D. (A) $\rightarrow$ (iv), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (i), (D) $\rightarrow$ (iii)`

Answer: B

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15. For combustion of 1 mole of benzene at $25^{\circ} C$, the heat of reaction at constant pressure is $-780.9 \quad \text{kcal}.$

What will be the heat of reaction at constant volume ?

$$C_6H_{6(l)} + 7\frac{1}{2}O_{2(g)} \rightarrow 6CO_{2(g)} + 3H_2O_{(l)}$$

A. $-781.8 \quad \text{kcal}$

B. -780.0 kcal

C. $+781.8 \text{ kcal}$

D. $+780.0 \text{ kcal}$

Answer: B

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16. Reaction of methanol with dioxygen was carried out and ΔU was found to be -726kJ mol^{-1} at 298 K. The enthalpy change for the reaction will be

$$CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}, \Delta H = -726 \text{kJ mol}^{-1}$$

A. $-741.5 \text{ kJ mol}^{-1}$

B. -727 kJ mol^{-1}

C. $+741.5 \text{ kJ mol}^{-1}$

D. $+727.2 \text{ kJ mol}^{-1}$

Answer: B

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17. According to the first law of thermodynamics, $\Delta U = q + w$. In special cases the statement can be expressed in different ways. Which of the following is not a correct expression ?

A. At constant temperature, $q = -w$

B. When no work is done , $\Delta U = q$

C. In gaseous system , $\Delta U = q + P\Delta V$

D. When work is done by the system : $\Delta U = q + w$

Answer: D

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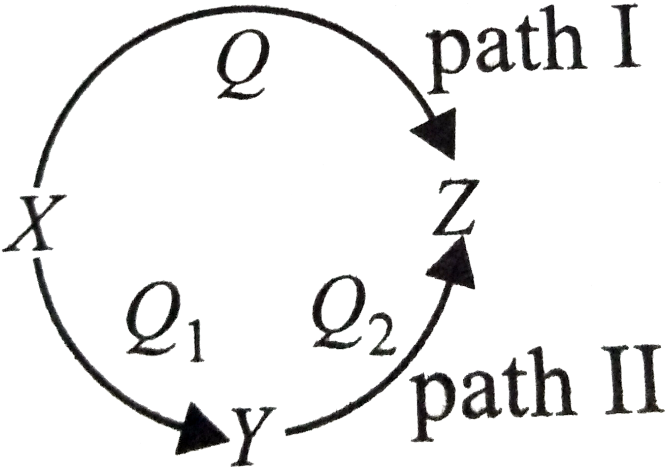
18. A reaction proceeds through two paths I and II to convert $X \rightarrow Z$.



What is the correct relationship between $Q. Q_1$ and Q_2 ?

A. $Q = Q_1 \times Q_2$

B. $Q = Q_1 + Q_2$

C. $Q = Q_2 - Q_1$

D. $Q = Q_1 / Q_2$

Answer: B

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19. What will be the standard internal energy change for the reaction at 298 K ?

$$OF_{2(g)}+H_2O_{(g)}+2HF_{(g)}, \Delta H^\circ = -310kJ$$

A. $-312.5Kj$

B. $-125.03kJ$

C. $-310kJ$

D. $-156kJ$

Answer: A

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20. The value for ΔU for the reversible isothermal evaporation of 90 g water at $100^{\circ} C$ will be $\left(\Delta H_{\text{evap}} \text{ of water } = 40.8 \text{ kJ mol}^{-1}, R = 8.314 \text{J K}^{-1} \text{mol}^{-1}\right)$

A. 4800 kJ

B. $188.494 kJ$

C. $40.8 kJ$

D. $125.03 kJ$

Answer: B

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21. A system changes from state X to Y with a change in internal energy measuring to 25 kJ mol^{-1}, by a reversible path and returns from Y to X by an irreversible path. What will be the net change in internal energy?

A. 25 kJ

B. gt 25 kJ

C. lt 25 kJ

D. zero

Answer: D

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22. What will be the change in internal energy when 12 kJ of work is done on the system and 2 kJ of heat is given by the system?

A. $+10kJ$

B. $-10kJ$

C. $+5kJ$

D. $-5kJ$

Answer: A

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23. A system absorbs 50 kJ heat and does 20 kJ of work. What is the net change in the internal energy of the system ?

A. Increase by 30 kJ

B. Decrease by 30 kJ

C. Increase by 70 kJ

D. Decrease by 70 kJ

Answer: A

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24. 200 joules of heat was supplied to a system at constant volume. It resulted in the increase in temperature of the system from 298 to 323 K. What is the change in internal energy of the system ?

A. 400 J

B. 200 J

C. 50 J

D. 150 J

Answer: B

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25. In thermodynamics, which one of the following properties is not an intensive property?

A. Presssure

B. Temperature

C. Volume

D. Density

Answer: C

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26. The molar heat capacity of water at constant pressure, C_p is $75\text{ J K}^{-1}\text{mol}^{-1}$. When 10 kJ of heat is supplied to 1 kg water which is free to expand, the increase in temperature of water is

A. 2.4 K

B. 4.8 K

C. 3.2 K

D. 10 K

Answer: A

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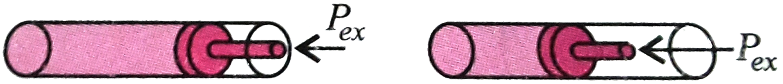
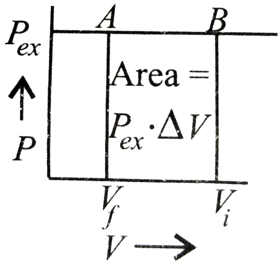
Mcqs

1. Work done on an ideal gas in a cylinder when it is compressed by and external pressure in a single step is shown below :

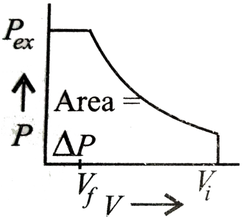


Which of the following graphs will show the work done on the gas ?

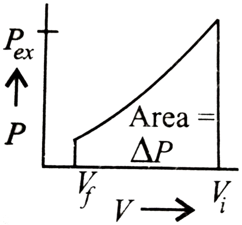
A.



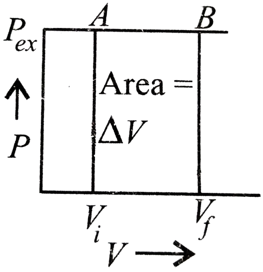
B.



C.



D.



Answer: A

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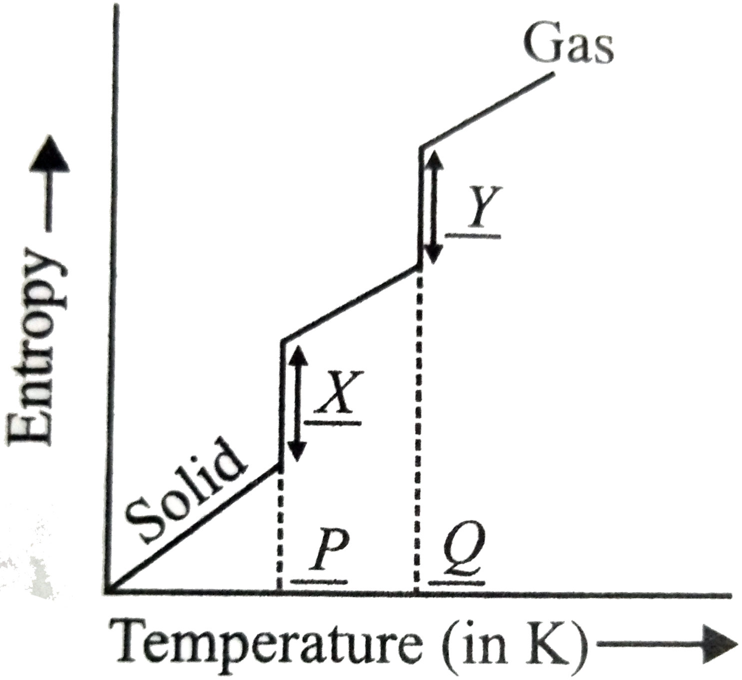
2. Study the following graph and fill in the blanks.



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Enthalpy Change Of A Reaction

1. Which of the following expressions is correct to calculate enthalpy of a reaction ?

A. $\Delta H_{\text{reaction}} = \Sigma \Delta_f H_{\text{reactions}} - \Sigma \Delta_f H_{\text{products}}$

B. $\Delta H_{\text{reaction}} = \Sigma B.\ E._{\text{products}} - \Sigma B.\ E._{\text{reactants}}$

C. $\Delta H_{\text{reaction}} = \Sigma B.\ E._{\text{reactants}} - \Sigma B.\ E._{\text{products}}$

D. $\Delta H_{\text{reaction}} = \Delta H_1 \times \Delta H_2 \times \Delta H_3 ...$

Answer: C

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2. If enthalpy of overall reaction $X \to Y$ along one route is $\Delta_r H$ and $\Delta_r H_1, \Delta_r H_2, \Delta_r H_3$.... Representing enthalpies of reactions leading to same product Y then $\Delta_r H$ is

A. $\Delta_r H = \Delta_r H_1 + \Delta_r H_2 + \Delta_r H_3 \dots$

B. $\Delta_r H = \Delta_r H_1 \times \Delta_r H_2 \times \Delta_r H_3 \dots$

C. $\Delta_r H = \Delta_r H_1 + \Delta_r H_2 - \Delta_r H_3 \dots$

D. $\Delta_r H = \frac{\Delta_r H_1 \times \Delta_r H_2 \times \Delta_r H_3}{2} \dots$

Answer: A

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3. Which of the following does not represent enthalpy change during phase transformation?

A. Standard enthalpy of fusion

B. Standard enthalpy of vaporisation

C. Standard enthalpy of sublimation

D. Standard enthalpy of formation

Answer: D

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

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

The heat of formation of SO_2 is : $-$

A. $(x+y)$

B. $(x-y)$

C. $(2x+y)$

D. $(2x-y)$

Answer: D

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5. Calculate the enthalpy of formation of ammonia from the following bond enegry data:

$(N-H)bond = 389kJmol^{-1}$, $(H-H)bond = 435kJmol^{-1}$, and $(N \equiv N)bond = 945.36kJmol^{-1}$.

A. $-41.82 \text{ kJ mol}^{-1}$

B. $+83.64 \text{ kJ mol}^{-1}$

C. $-945.36 \text{ kJ mol}^{-1}$

D. -833 kJ mol^{-1}

Answer: A

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6. The bond dissociation energy of gaseous H_2, Cl_2 and HCl are 104, 58 and $103kcalmol^{-1}$ respecitvely. Calculate the enthalpy of formation for HCl gas.

A. -22 kcal

B. $+22$ kcal

C. $+184$ kcal

D. -184 kcal

Answer: A

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7. What is the enthalpy change for the given reaction, if enthalpies of formation of Al_2O_3 and Fe_2O_3 are $-1670 \text{ kJ mol}^{-1}$ and -834 kJ mol^{-1} respectively?

$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

A. -836 kJ mol^{-1}

B. $+836 \text{ kJ mol}^{-1}$

C. -424 kJ mol^{-1}

D. $+424 \text{ kJ mol}^{-1}$

Answer: A

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8. What will be the heat of reaction for the following reaction? Will the reaction be exothermic or endothermic?

$Fe_2O_{3(s)} + 3H_{2(g)} \rightarrow 2Fe_{(s)} + 3H_2O_{(l)}$

$\Delta_f H^\circ (H_2O, l) = -285.83 \text{ kJ mol}^{-1}$

$\Delta_f H^\circ (Fe_2O_3, s) = -824.2 \text{ kJ mol}^{-1}$

A. $-824.\ 2 \text{ kJ mol}^{-1}$, exothermic

B. $+33.3 \text{ kJ mol}^{-1}$, endothermic

C. $-33.3 \text{ kJ mol}^{-1}$, exothermic

D. $+824.2 \text{ kJ mol}^{-1}$, endothermic

Answer: C

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9. For the reaction : $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl, \Delta H = -44 \text{ kcal}$

What is the enthalpy of decomposition of HCl?

A. $+\ 44\ \text{kcal/mol}$

B. $-44\ \text{kcal/mol}$

C. $-22\ \text{kcal/mol}$

D. $+22\ \text{kcal/mol}$

Answer: D

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10. For a reaction,

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

$\Delta_f H^\circ(CaO) = -631.1\ \text{kJ mol}^{-1}$

$\Delta_f H^\circ(CO_2) = -393.5\ \text{kJ mol}^{-1}$ and

$\Delta_f H^\circ(CaCO_3) = -1206.9\ \text{kJ mol}^{-1}$

Which of the following is a correct statement?

A. A large amount of heat is evolved during the decomposition of $CaCO_3$.

B. Decomposition of $CaCO_3$ is an endothermic process and heat is provided for decomposition

C. The amount of heat evolved cannot be calculated from the data provided .

D. $\Delta_f H^\circ = \Sigma \Delta_f H^\circ \quad (\text{reactants}) - \Sigma \Delta_f H^\circ \quad (\text{products})$

Answer: B

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11. Formation of ammonia is shown by the reaction,

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}, \Delta_f H^\circ = -91.8 \text{ kJ mol}^{-1}$

What will be the enthalpy of reaction for the decomposition of NH_3 according to the reaction ?

$2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}, \Delta_r H^\circ =$

A. $-91.8 \text{ kJ mol}^{-1}$

B. $+91.8 \text{ kJ mol}^{-1}$

C. $-45.9 \text{ kJ mol}^{-1}$

D. $+45.9 \text{ kJ mol}^{-1}$

Answer: B

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12. Hess's law is application for the determination of heat of heat of

A. transition

B. formation

C. reaction

D. all of these.

Answer: D

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13. "The change of enthalpy of a chemical reaction is the same whether the reaction takes place in one step or in several steps". This law was presented by:

A. Le Chatelier's law

B. vant's Hoff's law

C. first law of thermodynamics

D. Hess's law.

Answer: D

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Enthalpies For Different Type Of Reaction

1. The heat of combustion of ethane and benzene is -1560 and $-3268 \text{ kJ mol}^{-1}$ respectively. Which two has higher efficiency as fuel per gram and the amount of heat produced per gram?

A. Benzene, 41.9 kJ g^{-1}

B. Ethane, 52 kJ g^{-1}

C. Benzene, 78 kJ g^{-1}

D. Ethane, 30 kJ g^{-1}

Answer: B

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2. What will be the enthalpy change of conversion of graphite into diamon

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3. What will be the amount of heat evolved by burning 10 L of methane under standard conditions?

$-76.2, \ -398.8$ and $-241.6 \text{ kJ mol}^{-1}$ resepctively

A. 805.8kJ

B. 398.8 kJ

C. 359.7 kJ

D. 640.4 kJ

Answer: C

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4. For a reaction, $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

What is the relation between enthalpy of reaction (ΔH_r), enthalpy of formation of $CO_2(\Delta H_f)$ and enthalpy of combustion of carbon (ΔH_{comb}) ?

A. $\Delta H_r > \Delta H_f = \Delta H_{\text{comb}}$

B. $\Delta H_r = \Delta H_f = \Delta H_{\text{comb}}$

C. $\Delta H_r = \Delta H_f + \Delta H_{\text{comb}}$

D. $\Delta H_r = 2 \times \Delta H_f$

Answer: B

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5. The heat of combustion of C, S and CS_2 are $-393.3kJ, -293.7kJ$ and $-1108.76kJ$. What will be the heat of formation of CS_2 ?

A. $-128.02kJ$

B. $+970kJ$

C. $+1108.7kJ$

D. $+12kJ$

Answer: A

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6. How much heat is evolved if 3.2 g of methane is burnt and if the heat of combustion of methane is -880 kJ mol^{-1} ?

A. 88 kJ

B. 264 kJ

C. 176 kJ

D. 440 kJ

Answer: C

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7. What will be the enthalpy of combustion of carbon to produce carbon monoxide on the basis of data given below:

$$C_{(s)} + O_{2(g)} \to CO_{2(g)} - 393.4kJ$$

$$CO_{(g)} + \frac{1}{2}O_{2(g)} \to CO_{2(g)} - 283.0kJ$$

A. $+676.4kJ$

B. $-676.4kJ$

C. $-110.4kJ$

D. $+110.4kJ$

Answer: C

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8. Two reactions are given below :

$C_{(\text{graphite})} + O_{2(g)} \rightarrow CO_{2(g)}, \Delta H = -393.7kJ$

$C_{(\text{diamond})} \rightarrow C_{(\text{graphite})}, \Delta H = -2.1kJ$

What quantity of diamond will give 800 kJ of heat on burning ?

A. 24.25 g

B. 15.24 g

C. 2 g

D. 12.12 g

Answer: A

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9. Which of the following relationships is not correct ?

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

B. $\Delta H_{\text{sub}} = \Delta H_{\text{fusion}} + \Delta H_{\text{vap}}$

C. $\Delta H_r^\circ = \Sigma H^\circ_{f(\text{reactants})} - \Sigma^\circ_{f(\text{products})}$

D. $\Delta H_r^\circ = \Sigma\text{B.E. of reactants} \quad - \Sigma\text{B.E. of products}$

Answer: C

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10. Which of the following is not a correct statement about enthalpy of solution?

A. For most ionic compounds, $\Delta H^{\circ}_{\text{soln.}}$ is positive and the dissociation process is endothermic.

B. Solubility of most salts increases with increase in temperature.

C. If the lattice enthalpy is very high, the dissolution of compound becomes very easy.

D. Enthalpy of solution is determined by the selective values of the lattice enthalpy and hydration enthalpy.

Answer: C

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11. The enthalpy of solution of sodium chloride is $4kJmol^{-1}$ and its enthalpy of hydration of ion is $-784kJmol^{-1}$. Then the lattice enthalpy of $NaCl$ (in $kJmol^{-1}$) is

A. $+780\text{ kJ mol}^{-1}$

B. $+394 \text{ kJ mol}^{-1}$

C. $+788 \text{ kJ mol}^{-1}$

D. $+398 \text{ kJ mol}^{-1}$

Answer: C

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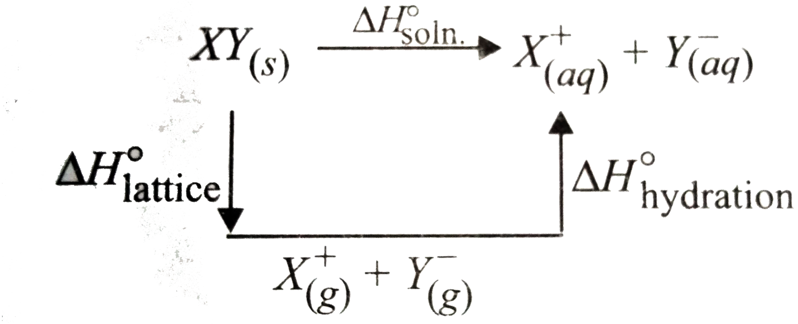
12. Study the figure given below and mark the correct expression.



The enthalpy of solution of $XY_{(s)}$, $\Delta H^{\circ}_{soln.}$ in water can be determined by

A. $\Delta H^{\circ}_{lattice} = \Delta H^{\circ}_{hyd} + \Delta H^{\circ}_{Soln.}$

B. $\Delta H^{\circ}_{hyd} = \Delta H^{\circ}_{lattice} + \Delta H^{\circ}_{soln.}$

C. $\Delta H^{\circ}_{\text{Soln.}} = \Delta H^{\circ}_{\text{lattice}} + \Delta H^{\circ}_{\text{hyd}}$

D. $\Delta H^{\circ}_{\text{soln}} = \Delta H^{\circ}_{\text{lattice}} \times \Delta H^{\circ}_{\text{hyd}}$

Answer: C

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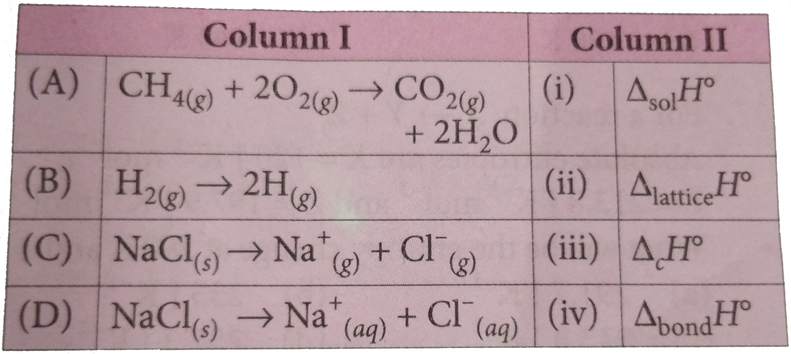
13. Match the column I with column II and mark the appropriate choice.



	Column I		Column II
(A)	$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O$	(i)	$\Delta_{sol}H^{\circ}$
(B)	$H_{2(g)} \rightarrow 2H_{(g)}$	(ii)	$\Delta_{lattice}H^{\circ}$
(C)	$NaCl_{(s)} \rightarrow Na^{+}_{(g)} + Cl^{-}_{(g)}$	(iii)	$\Delta_{c}H^{\circ}$
(D)	$NaCl_{(s)} \rightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)}$	(iv)	$\Delta_{bond}H^{\circ}$

A. (A) → (iv), (B) → (iii), (C) → (i), (D) → (ii)

B. (A) → (ii), (B) → (i), (C) → (iv), (D) → (iii)

C. (A) → (i), (B) → (ii), (C) → (iii), (D) → (iv)

D. (A) → (iii), (B) → (iv), (C) → (ii), (D) → (i)

Answer: D

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14. The amount of heat evolved when 0.50 mole of HCl is mixed with 0.30 mole of NaOH solution is

A. 57.1 kJ

B. 28.55 kJ

C. 11.42 kJ

D. 17.13 kJ

Answer: D

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15. Which of the following reactions will have the value of enthalpy of neutralisation as -57.1kJ mol^{-1} ?

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

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

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

D. $HCOOH + NaOH \rightarrow HCOONa + H_2O$

Answer: B

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16. Bond energies of $H - H$ and $Cl - Cl$ are 430 kJ mol^{-1} and 242 kJ mol^{-1} respectively. ΔH_f for HCl is 91 kJ mol^{-1}. What will be the bond energy of $H - Cl$?

A. 672 kJ

B. 182 kJ

C. 245 kJ

D. 88 kJ

Answer: C

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17. What will be ΔH for the reaction,

$CH_2Cl_2 \rightarrow C + 2H + 2Cl$?

(B.E. of $C - H$ and $C - Cl$ bonds are 416 kJ mol^{-1} and 325 kJ mol^{-1} respectively)

A. 832 kJ

B. 1482 kJ

C. 650 kJ

D. 1855 kJ

Answer: B

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18. ΔH for the reaction, $OF_2 + H_2O \to O_2 + 2HF$

(B.E. of $O - F, O - H, H - F$ and $O = O$ are 44, 111, 135 and $119 \text{ kcal mol}^{-1}$ respectively)

A. $-222 \quad \text{kcal}$

B. -88 kcal

C. -111 kcal

D. -79 kcal

Answer: D

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19. Dissociation of water takes place in two steps :

$H_2O \to H + OH, \qquad \Delta H = +497.8kJ$

$OH \to H + O, \qquad \Delta H = 428.5kJ$

Water is the bond energy of $O - H$ bond ?

A. $463.15 \text{ kJ mol}^{-1}$

B. $428.5 \text{ kJ mol}^{-1}$

C. 69.3 kJ mol^{-1}

D. $926.3 \text{ kJ mol}^{-1}$

Answer: A

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20. Bond energies of few bonds are given below :

$Cl - Cl = 242.8 \text{ kJ mol}^{-1}, H - Cl = 431.8 \text{ kJ mol}^{-1}.$

$O - H = 464 \text{ kJ mol}^{-1}, O = O = 442 kJmol^{-1}$

Using the B.E., calculate ΔH for the following reaction, $2Cl_2 + 2H_2O \rightarrow 4HCl + O_2$

A. 906 kJ mol^{-1}

B. $172.4 \text{ kJ mol}^{-1}$

C. $198.8 \text{ kJ mol}^{-1}$

D. 442 kJ mol^{-1}

Answer: B

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21. Which is the correct order of bond energy of single, double and triple bonds between carbon atoms ?

A. $C-C > C=C > C \equiv C$

B. $C=C > C \equiv C > C-C$

C. $C \equiv C > C-C > C=C$

D. $C \equiv C > C=C > C-C$

Answer: D

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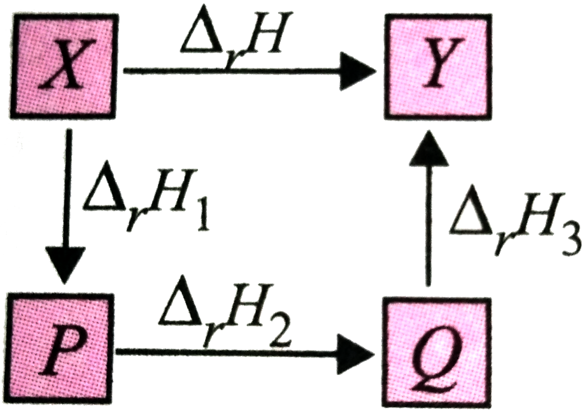
22. Which thermochemical process is shown by the following figure?



A. Standard enthalpy of a reaction

B. Born - Haber cycle of lattice enthalpy

C. Hess's law of constant heat summation

D. Standard entahlpy of a solution.

Answer: C

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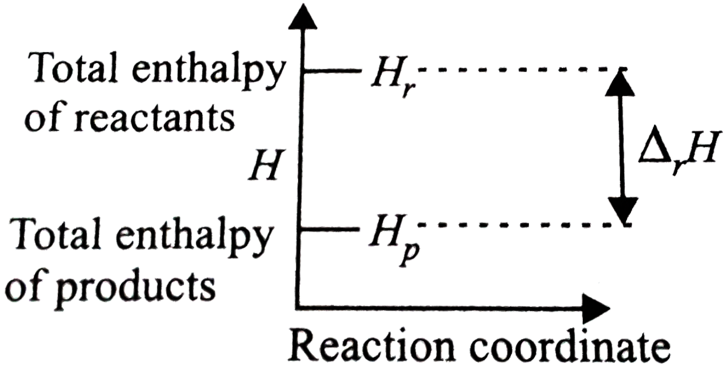
Spontaneity

1. The given enthalpy diagram reperesents which of the following reactions ?



A. Enthalpy diagram for endothermic reaction

B. Enthalpy diagram for exothermic reaction

C. Enthalpy diagram for reversible reaction

D. Enthalpy diagram for non-spontaneous reaction

Answer: B

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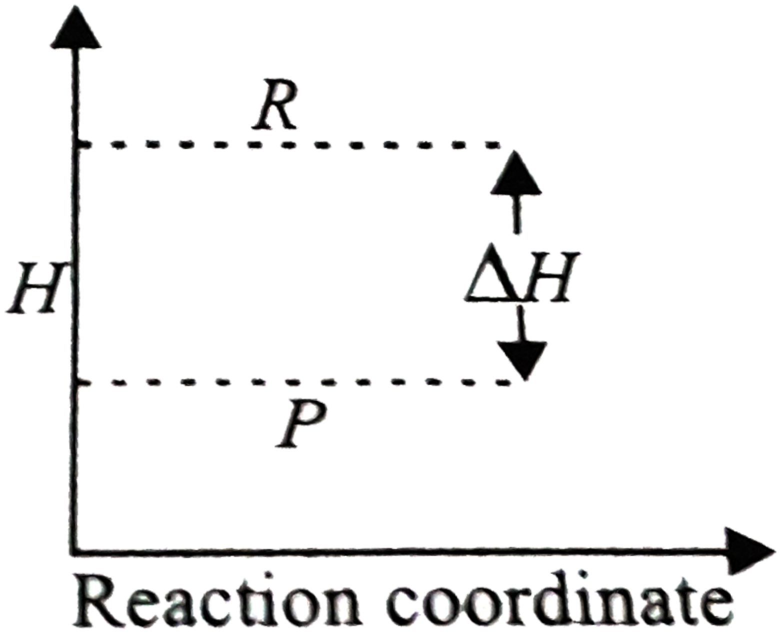
2. Study the given graph and choose the correct option.



A. $\Delta H =$ Net heat absorbed from the surroundings

B. $\Delta H =$ Net heat given to the surroundings

C. $\Delta H = +ve$ for the reaction

D. $\Delta H =$ Total energy possessed by the reactants

Answer: B

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3. In endothermic reactions,

A. reactants have more energy than products

B. reactants have less energy than products

C. reactants and products have same energy

D. reactants have lower temperature than products.

Answer: B

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4. The total entropy change $(\Delta S_{\text{total}})$ for the system and surrounding of a spontaneous process is given by

A. $\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surr}} > 0$

B. $\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surr}} < 0$

C. $\Delta S_{\text{system}} = \Delta S_{\text{total}} + \Delta S_{\text{surr}} > 0$

D. $\Delta S_{\text{surr}} = \Delta S_{\text{total}} + \Delta S_{\text{system}} < 0$

Answer: A

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5. Which of the following expressions regarding entropy is not correct?

A. $\Delta S_{\text{system}} = \dfrac{q}{T}$

B. $\Delta S_{\text{system}} = \Delta S_{\text{total}} + \Delta S_{\text{surrounding}}$

C. $\Delta S = \Delta S_{\text{final}} - S_{\text{initial}}$

D. $\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surrounding}}$

Answer: B

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6. For a reaction, $P+Q \rightarrow R+S$. The value of ΔH° is $-30\,\mathrm{kJ\,mol}^{-1}$ and ΔS is $-100\,\mathrm{J\,K}^{-1}\mathrm{mol}^{-1}$. At what temperature the reaction will be at equilibrium?

A. $27^{\circ}C$

B. $52^{\circ}C$

C. $30^{\circ}C$

D. $45^{\circ}C$

Answer: A

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7. Which of the following reactions will have the value of ΔS with a negative sign?

A. $H_2O_{(l)} \rightarrow H_2O_{(g)}$

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

C. $Cl_{2(g)} \rightarrow 2Cl_{(g)}$

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

Answer: B

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8. A reaction is at equilibrium at $100^{\circ} C$ and the enthalpy change for the reaction is 42.6 kJ mol^{-1}. What will be the value of ΔS in $\text{J K}^{-1}\text{mol}^{-1}$?

A. 120

B. 426.2

C. 373.1

D. 114.2

Answer: D

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9. Enthalpy change for the process,

$H_2O(\text{ice}) \Leftrightarrow H_2O(\text{water})$

is 6.01 kJ mol^{-1}. The entropy change of 1 mole of ice at its melting point will be

A. $12 \text{ J K}^{-1} \text{mol}^{-1}$

B. $22 \text{ J K}^{-1} \text{mol}^{-1}$

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

D. $30 \text{ J K}^{-1} \text{mol}^{-1}$

Answer: B

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10. At what temperature liquid water will be in equilibrium with water vapour?

$\Delta H_{\text{vap}} = 40.73 \text{ kJ mol}^{-1}, \Delta S_{\text{vap}} = 0.109 \text{ kJ K}^{-1} \text{mol}^{-1}$

A. 282.4 K

B. 373.6 K

C. 100 K

D. 400 K

Answer: B

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11. For a reaction: $X \to Y + Z$

Absolute entropies are $X = 120 \text{ J K}^{-1}\text{mol}^{-1}$,

$Y = 213.8 \text{ J K}^{-1}\text{mol}^{-1}$ and $Z = 197.9 \text{ J K}^{-1}\text{mol}^{-1}$.

What will be the entropy change at 298 K and 1 atm?

A. 291.7 J K^{-1}

B. 255 J K^{-1}

C. $213.8 JK^{-1}$

D. 257.3 J K^{-1}

Answer: A

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12. What will be the melting point of KCl if enthalpy change for the reaction is 7.25 J mol^{-1} and entropy change is $0.007 \text{ J K}^{-1}\text{mol}^{-1}$?

A. 1835.2 K

B. 173 K

C. 1035.7 K

D. 1285.2 K

Answer: C

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13. For reversible reaction : $X_{(g)} + 3Y_{(g)} \Leftrightarrow 2Z_{(g)}, \Delta H = -40 \text{ kJ}$ Standard entropies of X, Y and Z are 60, 40and 50 J K^{-1},ol^{-1}

respectively. The temperature at which the above reaction is in equilibrium is

A. 273 K

B. 600 K

C. 500 K

D. 400 K

Answer: C

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14. At 373 K, steam and water are in equilibrium and $\Delta H = 40.98 \text{ kJ mol}^{-1}$. What will be ΔS for conversion of water into system ?

$H_2O_{(l)} \rightarrow H_2O_{(g)}$

A. $109.8 \text{ J K}^{-1}\text{mol}^{-1}$

B. $31 \text{ J K}^{-1}\text{mol}^{-1}$

C. $21.98 \text{ J K}^{-1}\text{mol}^{-1}$

D. $326 \text{ J K}^{-1}\text{mol}^{-1}$

Answer: A

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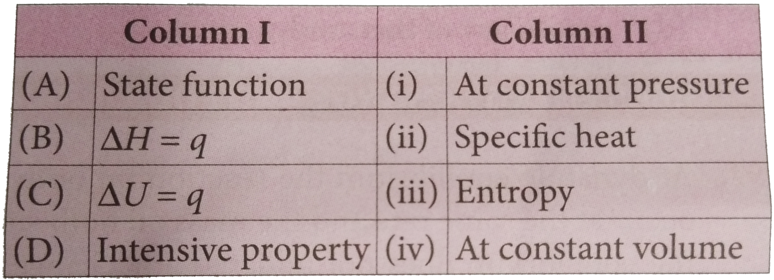
15. Match the column I with column II and mark the appropriate choice.



	Column I		Column II
(A)	State function	(i)	At constant pressure
(B)	$\Delta H = q$	(ii)	Specific heat
(C)	$\Delta U = q$	(iii)	Entropy
(D)	Intensive property	(iv)	At constant volume

A. (A) $\rightarrow$ (iii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (iv), (D) $\rightarrow$ (ii)

B. (A) $\rightarrow$ (ii), (B) $\rightarrow$ (iv), (C) $\rightarrow$ (i), (D) $\rightarrow$ (ii)

C. (A) $\rightarrow$ (ii), (B) $\rightarrow$ (iv), (C) $\rightarrow$ (iii), (D) $\rightarrow$ (i)

D. (A) $\rightarrow$ (iii), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (i), (D) $\rightarrow$ (iv)

Answer: A

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16. Read the following statements regarding spontaneity of a process and mark the appropriate choice.

(i) When enthalpy factor is absent then randomness factor decides spontaneity of a process.

(ii) When randomness factor is absent then enthalpy factor decides spontaneity of a process.

(iii) When both the factors take place simultaneously, the magnitude of both of factors decide spontaneity of a process.

A. Statements (i) and (ii) are correct and (iii) is incorrect.

B. Statement (iii) is correct, (i) and (ii) are incorrect.

C. Statements (i), (ii) and (iii) are correct.

D. Statements (i), (ii) and (iii) are incorrect.

Answer: C

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17. Which of the following processes is a non-spontaneous process?

A. Dissolution of salt of sugar in water

B. Mixing of different gases through diffusion

C. Precipitation of copper when zinc rod is dipped in aqueous solution of copper sulphate

D. Flow of heat from a cold body to a hot body in contact

Answer: D

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18. Which of the following statements regarding Gibb's energy change is correct?

A. If ΔG is negative (lt 0), the process is non-spontaneous.

B. If ΔG is positive (gt 0), the processis spontaneous.

C. If ΔG is negative (lt 0), the process is spontaneous.

D. If ΔG is positive (gt 0), the process is in equilibrium.

Answer: C

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19. For a reaction to be spontaneous at any temperature, the conditions are

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

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

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

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

Answer: D

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20. For the reaction given below the value of standard Gibbs free energy of formation at 298 K are given. What is the nature of the reaction?

$I_2 + H_2S \rightarrow 2HI + S$

$\Delta S_f^\circ(HI) = 1.8 \text{ kJ mol}^{-1}, \Delta G_f^\circ(H_2S) = 33.8 \text{ kJ mol}^{-1}$

A. Non-spontaneous in forward direction.

B. Spontaneous in forward direction.

C. Spontaneous in backward direction.

D. Non-spontaneous in both forward and backward directions.

Answer: B

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21. What is the entropy change when 1 mole oxygen gas expands isothermally and reversibly from an initial volume of 10 L to 100 L at 300

K ?

A. 19.14 J K^{-1}

B. 109.12 J K^{-1}

C. 29.12 J K^{-1}

D. 10 J K^{-1}

Answer: A

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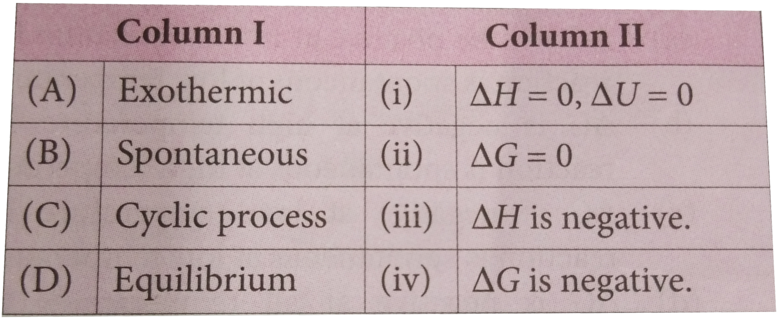
22. Mathc the following columns and mark the appropriate choice.



Column I		Column II	
(A)	Exothermic	(i)	$\Delta H = 0, \Delta U = 0$
(B)	Spontaneous	(ii)	$\Delta G = 0$
(C)	Cyclic process	(iii)	ΔH is negative.
(D)	Equilibrium	(iv)	ΔG is negative.

A. (A) → (ii), (B) → (iii), (C) → (i), (D) → (iv)

B. (A) $\rightarrow$ (iv), (B) $\rightarrow$ (i), (C) $\rightarrow$ (iii), (D) $\rightarrow$ (ii)

C. (A) $\rightarrow$ (i), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (iv), (D) $\rightarrow$ (iii)

D. (A) $\rightarrow$ (iii), (B) $\rightarrow$ (iv), (C) $\rightarrow$ (i), (D) $\rightarrow$ (ii)

Answer: D

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23. One word answer is given for the following definitions, Mark the one which is incorrect.

A. The process in which temperature remains constant : Isobaric

B. The process in which volume remains constant : Isochoric

C. The relation between ΔH and ΔH when all the reactants and products are solid : $\Delta H = \Delta U$

D. The relation between $\Delta G, \Delta H$ and ΔS:

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

Answer: A

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24. In a reaction $P + Q \rightarrow R + S$, there is no change in entropy, Enthalpy change for the reaction (ΔH) is 12 kJ mol^{-1}. Under what conditions, reaction will have negative value of free energy change?

A. If ΔH is positive

B. If ΔH is negative.

C. If ΔH is 24 kJ mol^{-1}.

D. If temperature of reaction is high

Answer: B

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25. For reaction, $2K_{(g)}+L_{(g)}\rightarrow 2M_{(g)}, \Delta U^{\circ} = -10.5 \text{ KJ and } \Delta S^{\circ} = -44.1 \text{ J K}^{-1}$. Calculate ΔG° for the reaction and predict whether the reaction will be spontaneous or non-spontaneous?

A. $\Delta G = +0.16 \text{ kJ, non-spontaneous}$

B. $\Delta G = -0.16 \text{ kJ, spontaneous}$

C. $\Delta G = +26.12 \text{ kJ, non-spontaneous}$

D. $\Delta G = -26.12 \text{ kJ, spontaneous}$

Answer: A

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26. Which of the following statements is not correct ?

A. For a spontaneous process, ΔG must be negative.

B. Enthalpy, entropy, free energy etc. are state variables.

C. A spontaneous process is reversible in nature.

D. Total of all possible kinds of energy of a syste is called its internal energy.

Answer: C

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27. ΔG is the net energy available to do useful work and is a measure of free energy. If a reaction has positive enthalpy change and positive entropy change, under what conditions will the reaction be spontaneous?

A. ΔG will be positive at low temperature hence reaction is spontaneous at low temperature.

B. ΔG is negative at high temperature hence reaction is spontaneous at high temperature.

C. ΔG is negative at low temperature.

D. ΔG is negative at all temperature hence reaction is spontaneous at all temperatures.

Answer: B

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28. Dissolution of ammonium chloride in water is an endothermic reaction, yet it is a spontaneous process. This is due to the fact that

A. $\Delta H \text{ is } +ve, \Delta S \text{ is } -ve$

B. $\Delta H \text{ is } -ve, \Delta S \text{ is } +ve$

C. $\Delta H \text{ is } +ve, \Delta S \text{ is } +ve \text{ and } \Delta H < T\Delta S$

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

Answer: C

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29. What will be the signs of ΔH and ΔS when NaOH is dissolved in water?

A. $\begin{array}{cc} \Delta H & \Delta S \\ - & - \end{array}$

B. $\begin{array}{cc} \Delta H & \Delta S \\ + & - \end{array}$

C. $\begin{array}{cc} \Delta H & \Delta S \\ - & + \end{array}$

D. $\begin{array}{cc} \Delta H & \Delta S \\ + & + \end{array}$

Answer: C

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30. At absolute zero, the entropy of a pure crystal is zero. This is

A. first law of thermodynamics

B. second law of thermodynamics

C. third law of thermodynamics

D. zeroth law of thermodynamics

Answer: C

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Gibbs Energy Change And Equilibrium

1. At dynamic equilibrium the reaction on both sides occur at the same rate and the mass on both sides of the equilibrium does not undergo any change. This condition can be achieved only when the value of ΔG is

A. -1

B. $+1$

C. $+2$

D. 0

Answer: D

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2. 300 पर एक अभिक्रिया के लिए साम्य स्थिरांक 10 है| $\Delta G^{\ominus}$ का मान क्या होगा ?

$R = 8.314 J K^{-1} \text{mol}^{-1}$

A. $-5.74 kJ$

B. $-574 kJ$

C. $+11.48 kJ$

D. $+5.74 kJ$

Answer: A

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3. A reaction attains equilibrium state under standard conditions, then what is incorrect for this?

A. Equilibrium constant K = 0

B. Equilibrium constant K = 1

C. $\Delta G^{\circ} = 0$ and $\Delta H^{\circ} = T \Delta S^{\circ}$

D. $\Delta S = 0$ and $\Delta H = T\Delta S$

Answer: A

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4. Which is the correct relationship between ΔG° and equilibrium constant K_p?

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

B. $K_p = [E/RT]^{\Delta G^{\circ}}$

C. $K_p = -\Delta G^{\circ}/RT$

D. $K_p = e^{-\Delta G^{\circ}/RT}$

Answer: D

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Higher Order Thinking Skills

1. A ideal gas does work on its surroundings when it expands by 2.5 L against external pressure 2 atm. This work done is used to heat up 1 mole of water at 293 K. What would be the final temperature of water in kelvin if specific heat for water is $4.184 \text{ Jg}^{-1}\text{K}^{-1}$?

A. 300

B. 600

C. 200

D. 1000

Answer: A

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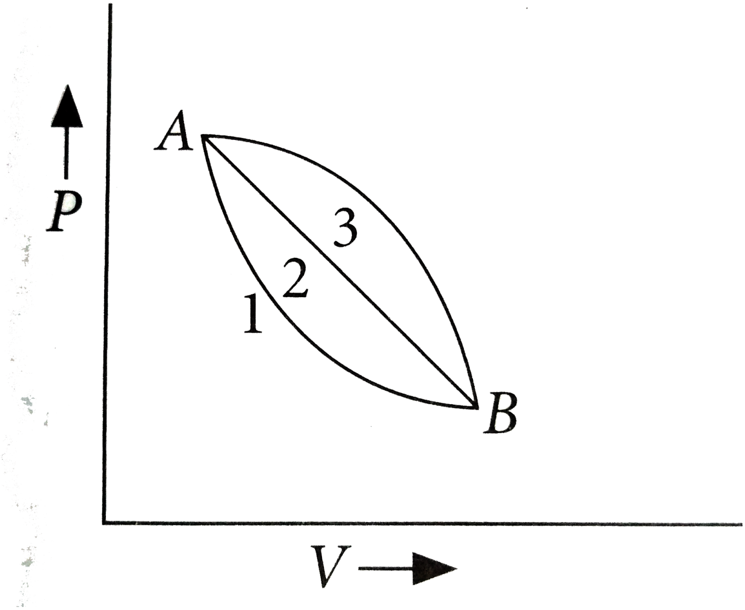
2. A given mass of gas expands from state A to state B by three paths 1, 2, and 3 as shown in the figure :



If w_1, w_2 and w_3 respectively, be the work done by the gas along three paths, then

A. $w_1 > w_2 > w_3$

B. $w_1 < w_2 < w_3$

C. $w_1 = w_2 = w_3$

D. $w_1 < w_2, w_1 < w_3$

Answer: B

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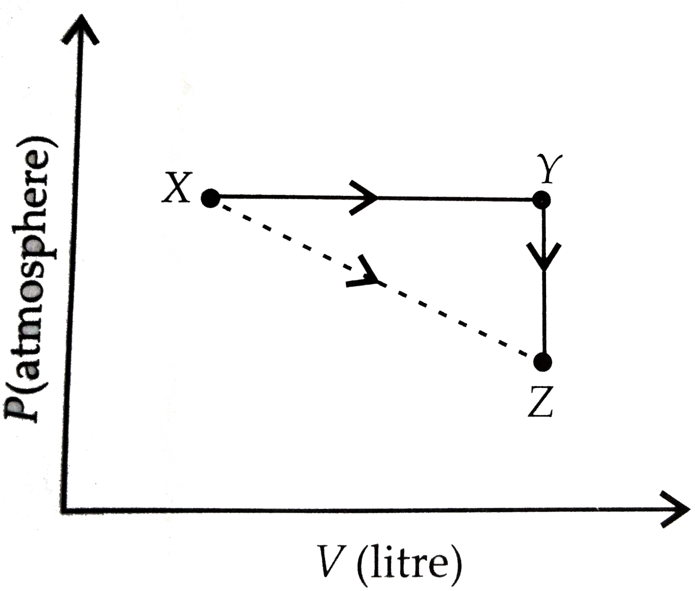
3. For an ideal gas, consider only P-V work in going from an initial state X to the final state Z. The final state Z can be reached by either of the two paths shown in the figure. Which of the following choice(s) is(are) correct? [Take ΔS as change in entropy and w as work done]



A. $\Delta S_{X \rightarrow Z} = \Delta S_{X \rightarrow Y} + \Delta S_{Y \rightarrow Z}$

B. $w_{X \rightarrow Z} = w_{X \rightarrow Y} + w_{Y \rightarrow Z}$

C. $w_{X \rightarrow Y \rightarrow Z} \neq w_{X \rightarrow Y}$

D. $\Delta S_{X \rightarrow Y \rightarrow Z} = \Delta S_{X \rightarrow Y}$

Answer: A

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4. H_2 gas is mixed with air at $25^\circ C$ under a pressure of 1 atmosphere and exploded in a closed vessel. The heat of the reaction, $H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(v)}$ at constant volume, $\Delta U_{298\text{ K}} = -240.60 \text{ kJ mol}^{-1}$ and C_V values for GH_2O vapour and N_2 in the temperature range 298 K and 3200 K are $39.06 \text{ JK}^{-1}\text{mol}^{-1}$ and $26.40 \text{ JK}^{-1}\text{mol}^{-1}$ respectively. The explosion temperature under adiabatic conditions is

(Given : $n_{N_2} = 2$)

A. 2900 K

B. $2900^\circ C$

C. 2917 K

D. $3000^\circ C$

Answer: C

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5. Bond dissociation enthalpies of $H_{2(g)}$ and $N_{2(g)}$ are $426.0\ \mathrm{kJ\ mol}^{-1}$ and $941.8\ \mathrm{kJ\ mol}^{-1}$, respectively, and enthalpy of formation of $NH_{3(g)}$ is $-46\ \mathrm{kJ\ mol}^{-1}$. What are the enthalpy of atomisation of $NH_{3(g)}$ and the average bond enthalpy of $N-H$ bond respectively (in kJ mol^{-1})?

A. 1170.9, 390.3

B. 117, 300

C. 300, 200

D. 2000, 1975

Answer: A

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6. Consider the following two reactions :

(i) $\text{Propene } + H_2 \rightarrow \text{Propane}, \quad \Delta H_1$

(ii) $\text{Cyclopropane} + H_2 \rightarrow \text{Propane}, \quad \Delta H_2$

Then, $\Delta H_2 - \Delta H_1$ will be

A. 0

B. $2BE_{C-C} - BE_{C=C}$

C. $BE_{C=C}$

D. $2BE_{C=C} - BE_{C-C}$

Answer: B

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7. A gaseous system is initially characterised by 500 mL volume and 1 atm pressure at 298 K. This system is allowed to do work as

In isobaric conditions it expands to 800 mL resulting a decrease in pressure and temperature to 0.6 atm and 273 K respectively.

(ii) In adiabatic conditions it is allowed to expand upto 800 mL and results a decrease in pressure and temperature to 0.6 atm and 273 K respectively.

If Gibbs energy change in (i) is ΔG_a and in (ii) is ΔG_b, then what will be the ration of $\frac{\Delta G_a}{\Delta G_b}$?

A. 0

B. 1

C. between 0 -1

D. gt 1

Answer: B

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8. What will be ΔG for the reaction at $25^{\circ} C$ when partial pressures of reactants H_2, CO_2, H_2O and CO are 10, 20, 0.02 and 0.01 atm respectively. (Given : $G^{\circ}_{H_2O} = -228.58 \text{ kJ}, \ G^{\circ}_{CO} = -137{,}15 \text{ kJ}, \ G^{\circ}_{CO} = -394.37 \text{ kJ.)}$

A. $+5.61kJ$

B. $-5.61kJ$

C. $7.09kJ$

D. $-8.13kJ$

Answer: B

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Ncert Exemplar

1. Thermodynamics is not concerned about ______.

A. energy changes involved in a chemical reaction

B. the extent to which a chemical reaction proceeds

C. the rate at which a reaction proceeds

D. the feasibility of a chemical reaction

Answer: C

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2. Which of the following statements is correct?

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

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

C. The presnce of reactants in a closed vessel made up of copper is an example of a closed system.

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

Answer: C

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3. The state of gas can be described by quoting the relationship between

A. pressure, volume, temperature

B. temperature, amount, pressure

C. amount, volume, temperature

D. pressure, volume, temperature, amount

Answer: D

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

A. be reduced to half

B. be doubled

C. remain constant

D. be increased four times

Answer: C

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5. ΔU° of combustion of $CH_{4(g)}$ at certain temperature is -393 kJ mol^{-1}. The value of ΔH° is

A. zero

B. $< \Delta H^{\circ}$

C. $> \Delta U^{\circ}$

D. equal to ΔU°

Answer: B

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6. In an adiabatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following.

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

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

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

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

Answer: C

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7. The pressure-volume work for an ideal gas can be calculated by using the expression $W = -\int_{V_i}^{V_f} P_{ex} dV$. The work can also be calculated from the pV - plot by using the area under the curve within the specified limits. When an ideal gas is compressed (i) reversibly or (ii) irreversibly from volume V_i to V_f. Choose the correct option.

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

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

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

D. $W_{\text{reversible}} = W_{\text{irreversible}} + P_{ex}\Delta V$

Answer: B

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8. The entropy change can be calculated by using the expression, $\Delta S = \frac{q_{\text{rev}}}{T}$. When water freezes in a glass beaker, choose the correct statement amongst the following:

A. ΔS_{system} decreases but $\Delta S_{\text{surroundings}}$ remains the same.

B. ΔS_{system} increases but $\Delta S_{\text{surroundings}}$ decreases.

C. ΔS_{system} decrease but $\Delta S_{\text{surroundings}}$ increases.

D. ΔS_{system} decreases and $\Delta S_{\text{surroundings}}$ also decreases.

Answer: C

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9. Consider the reactions given below. On the basis of these reactions find out which of the algebric relations given in options (a) to (d) is correct ?

(i) $C_{(g)} + 4H_{(g)} \rightarrow CH_{4(g)}, \Delta_r H = x \text{ kJ mol}^{-1}$ (ii) $C_{(\text{graphite, s})} + 2H_{2(g)} \rightarrow CH_{4(g)}, \Delta_r H = \text{y kJ mol}^{-1}$

A. x = y

B. x = 2y

C. x gt y

D. x lt y

Answer: C

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10. The enthalpies of elements in their standard states are taken as zero.

The enthalpy of formation of a compound

A. is always negative

B. is always positive

C. may be positive or negative

D. is never negative

Answer: C

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11. Enthalpy of sublimation of a substance is equal to

A. enthalpy of fusion + enthalpy of vapourisation

B. enthalpy of fusion

C. enthalpy of vapourisation

D. twice the enthalpy of vapourisation.

Answer: A

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Assertion And Reason

1. Assertion : The presence of reactants in a closed vessel made of conducting material is an example of a closed system.

Reason : In a closed system, there is no exchange of matter but exchange of energy is possible between the system and the surroundings.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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2. Assertion : In adiabatic system, $\Delta U = w_{ad}.$

Reason : In adiabatic system, no transfer of heat takes place.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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3. Assertion (A): Internal energy change in a cyclic process is zero.

Reason (R) : Internal energy is a state funciton.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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4. Assertion : Work done during free expansion of an ideal gas whether reversible or irreversible is positive.

Reason : During free expansion, external pressure is always less than the pressure of the system.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D

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5. Assertion : The difference between $\Delta H \text{ and } \Delta U$ is not significant for systems consisting of only solids and/or liquids.

Reason : Solids and liquids do not suffer any significant volume changes upon heating.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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6. Assertion : For the change, $H_2O_{(l)} \rightarrow H_2O_{(s)}, \Delta H = \Delta U$.

Reason : No enthalpy change is involved in this process.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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7. Assertion : ΔH for an exothermic reaction is negative nad for an endothermic reaction is positive.

Reason : Enthalpy is an extensive property.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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8. Assertion : The enthalpy change for the reaction $CaO_{(s)} + CO_{2(g)} \rightarrow CaCO_{3(s)}$ is calld enthalpy of formation of calcium carbonate.

Reason : The reaction involves formation of 1 mole of $CaCO_3$ from its constituent elements.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D

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9. Assertion : The solubility of most salts in water increases with rise of temperature.

Reason : For most of the ionic compounds, $\Delta_{\text{sol}}H^{\circ}$ is positive and the dissociation process is endothermic.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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10. Assertion : Heat of neutralisation of HNO_3 and $NaOH$ is same as that of HCl and KOH.

Reason : Both HNO_3 and HCl are storng acids and NaOH and KOH are strong bases.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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11. Assertion : Heat added to a system at lower temperature causes greater randomness than when the same quantity of heat is added to it at higher temperature.

Reason : Entropy is a measure of the degree of randomness or disorder in the system.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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12. Assertion : In the proces, $H_{2(g)} \to 2H_{(g)}$ .entropy increases.

Reason : Breaking of bonds is an endothermic process.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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13. Assertion : An exothermic process which is non-spontaneous at high temperature may become spontaneous at low temperature.

Reason : Spontaneous process is an irreversible process and may be reversed by some external agency.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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14. Assertion : If both ΔH° and ΔS° are positive then reaction will be spontaneous at high temperature.

Reason : All processes with positive entropy chang are spontaneous.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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15. Assertion : Third law of thermodynamics is confined to pure crystalline solids.

Reason : Theoretical arguments and practical evidences have shown that entropy of solutions and supar cooled liquids is not zero at 0 K.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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