CHEMISTRY

BOOKS - MODERN PUBLICATION CHEMISTRY (KANNADA ENGLISH)

THERMODYNAMICS

Multiple Choice Questions Level I

1. Which of the folowing is not an intensive property ?

    A. Entropy

    B. Pressure

    C. Temperature

    D. Molar volume

Answer: A

2. An adiabatic process is one in which :

A. $\Delta U = q$

B. $\Delta U < w$

C. q = 0

D. $q = p\Delta V$

Answer: C

3. If temperature remains constant during the process. It is called an :

A. Isothermal process

B. Adiabatic process

C. Isobaric process

D. Isochoric process

Answer: A

4. In an exothermic reaction (H_r = enthalpy of reactants and H_p = enthalpy of products)
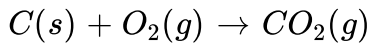
A. $H_r < H_p$

B. $H_r > H_p$

C. $H_r = H_p$

D. $H_r \neq H_p$ and $H_p = 0$

Answer: B

5. For the reaction :

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

A. $\Delta H < \Delta U$

B. $\Delta H > \Delta U$

C. $\Delta H = \Delta U$

D. $\Delta H = 0$

Answer: C

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6. In a bomb calorimeter, the heat of reaction is measured at :

A. Constant volume

B. Constant pressure

C. Constant volume and constant pressure

D. None of these.

Answer: A

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7. In an adiabatic expansion of an ideal gas.

A. $\Delta T = 0$

B. w = 0

C. q = 0

D. $\Delta U = 0$.

Answer: C

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8. If q is the heat added to the system, w is the work done by the system and ΔU is the change in internal energy, then according to first law of thermodynamics :
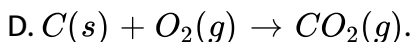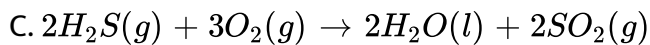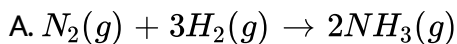
A. $\Delta U = q + w$

B. $\Delta U = q - w$

C. $\Delta U = q + p\Delta V$

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

Answer: B

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9. For which of the following reactions, ΔH is equal to ΔU ?

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

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

C. $2H_2S(g) + 3O_2(g) \rightarrow 2H_2O(l) + 2SO_2(g)$

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

Answer: D

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10. For the reaction :

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

A. $\Delta H = \Delta U$

B. $\Delta H > \Delta U$

C. $\Delta H < \Delta U$

D. $\Delta H = 0.$

Answer: B

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11. Which of the folowing is not a state function ?

A. Heat

B. Internal energy

C. Enthalpy

D. Entropy.

Answer: A

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12. For a chemical reaction at constant P, ΔH is equal to

A. zero

B. ΔU

C. q/T

D. $\Delta U + p\Delta V$

Answer: D

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13. Which of the following quantities is not a state function ?

A. Temperature

B. Entropy

C. Enthalpy

D. Work.

Answer: D

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14. In an isothermal expansion of an ideal gas

A. q = 0

B. $\Delta V = 0$

C. $\Delta U = 0$

D. w = 0

Answer: C

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15. For a chemical reaction at constant P and V. ΔH is equal to

A. ΔU

B. zero

C. $\Delta U + P\Delta V$

D. p/T.

Answer: A

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16. $(\Delta U - \Delta H)$ for the formation of NH_3 from N_2 and H_2 is :

A. $-2RT$

B. 2 RT

C. RT

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

Answer: C

17. A system absorbs 10 kJ of heat at constant volume and its temperature rises from $27°C$ to $37°C$. The value of ΔU is :

A. 100 kJ

B. 10 kJ

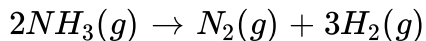C. 0

D. 1 kJ

Answer: B

18. For the reaction :

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

A. $q_p = (q_v)^2$

B. $q_p = q_v - 2RT$

C. $q_p = q_v + 2RT$

D. $q_p = 2q_v - R.$

Answer: C

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19. If ΔH is the change in enthalpy and ΔE is the change in internal

energy accompanying a gaseous reaction then

A. ΔH is always greater than ΔU

B. $\Delta H > \Delta U$ only the number of moles of the reactnts is greater

than the number of mole of products
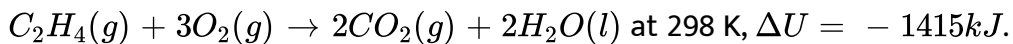
C. ΔH is always less than ΔU

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

number of moles of reactants.

Answer: D

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20. For the reaction :

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ at 298 K, $\Delta U = -1415kJ.$

If $R = 0.0084kJJK^{-1}$. Then ΔH is equal to

A. $-1400kJ$

B. $-1410kJ$

C. $-1420kJ$

D. $-1430kJ.$

Answer: C

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

A. $\Delta U = w \neq 0, q = 0$

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

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

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

Answer: A

22. An adiabatic process occurs in

A. open system

B. closed system

C. isolated system

D. in all given systems

Answer: C

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

A. reduce to half

B. be doubled

C. remain constant

D. increase four times

Answer: C

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24. Molar heat capacity of ethenol is $110.4 JK^{-1} mol^{-1}$. Its specific heat capacity is

A. 2.4

B. 55.2

C. 5.078 kJ

D. 110.4

Answer: A

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25. For an ideal gas, C_p and C_v are related as

A. $C_p - C_v = R$

B. $\dfrac{C_p}{C_v}$

C. $C_p + C_v = R$

D. $C_v - C_p = R$

Answer: A

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26. Molar heat capacity of aluminium is $25 JK^{-1}mol^{-1}$. The heat necessary to raise the temperature of 54 g of aluminium (atomic mass $27 gmol^{-1}$) from $30°C$ to $50°C$ is

A. 1.5 kJ

B. 0.5 kJ

C. 1.0 kJ

D. 2.5 kJ

Answer: C

27. The molar heat capacity of Al is $24 Jmol^{-1}K^{-1}$. The energy required to raise the temperature of 60.0g of Al from $25°C$ to $45°C$ is

A. 3.2 kJ

B. 1.07 kJ

C. 10.1 kJ

D. 2.40 kJ

Answer: B

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28. Calculate the amount of heat that must be supplied to raise the temperature of 2 kg of water from $25°C$ to its boiling point at one atmospheric pressure. The average specific heat of water in the range $25 - 100°C$ is $4.184 JK^{-1}g^{-1}$.

A. 628 kJ

B. 418.4 kJ

C. 209.2 kJ

D. 108.6 kJ

Answer: A
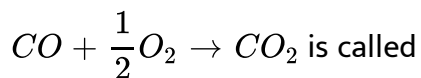
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29. The heat change for the reaction.

$CO + \dfrac{1}{2}O_2 \rightarrow CO_2$ is called

   A. heat of reaction

   B. heat of formation

   C. heat of neutralisation

   D. heat of combustion.

Answer: D

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30. The heat of formation of Fe_2O_3 is -824.2 kJ mol^{-1}. ΔH for the reaction $2Fe_2O_3(s) \rightarrow 4Fe(s) + 3O_2(g)$ is :

A. $-412.1kJ$

B. $-1648.4kJ$

C. $-3296.8kJ$

D. 1648.4 kJ

Answer: D

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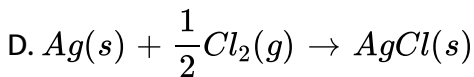
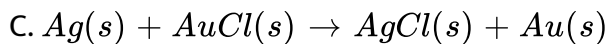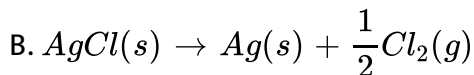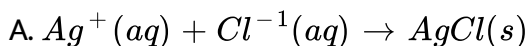**31.** Which of the following enthalpies is always negative ?

A. Enthalpy of solution

B. Enthalpy of combustion

C. Enthalpy of sublimination

D. Enthalpy of formation.

Answer: B

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32. Which of the following reaction represents enthalpy of formation of AgCl ?

A. $Ag^+(aq) + Cl^{-1}(aq) \rightarrow AgCl(s)$

B. $AgCl(s) \rightarrow Ag(s) + \frac{1}{2}Cl_2(g)$

C. $Ag(s) + AuCl(s) \rightarrow AgCl(s) + Au(s)$

D. $Ag(s) + \frac{1}{2}Cl_2(g) \rightarrow AgCl(s)$

Answer: D

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33. The variation of heat of reaction with temperature is given by an equation known as

    A. Van't Hoff equation

    B. Van der Waals equation

    C. Kirchoff's equation

    D. Gibbs Helmholtz equation.

Answer: C

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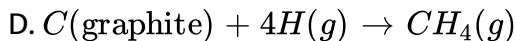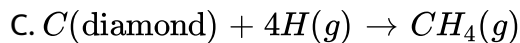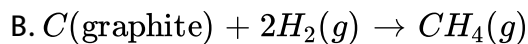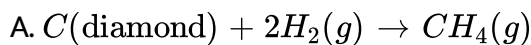**34.** Which of the following pairs has heat of neutralisation equal to -57.1 kJ mol^{-1}?

    A. $HNO_3.\ KOH$

    B. $HCl.\ NH_4OH$

    C. $H_2SO_4.\ NH_4OH$

D. $CH_3COOH. NaOH.$

Answer: A

35. Which of the following equation represents standard heat of formation of methane ?

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

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

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

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

Answer: B

36. The enthalpies of formation of N_2O and NO at 298 K are 82 and 90 $kJmol^{-1}$. The enthalpy of the reaction :

$N_2O(g) + \dfrac{1}{2}O_2 \rightarrow 2NO(g)$ is
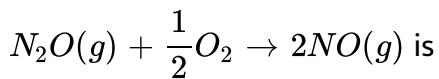
A. $-8kJ$

B. 98 kJ

C. $-74kJ$

D. 8 kJ

Answer: B

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37. The enthalpies of combustion of carbon and carbon monoxide are -393.5 and $-283.0kJmol^{-1}$ respectively. The enthalpy of formation of carbon monoxide is :

A. $-676.5kJ$

B. 110.5 kJ

C. $-110.5kJ$

D. 676.5 kJ

Answer: C

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38. The enthalpies of combustion of rhombic sulphur and monoclinic sulphur are -295.1 and $-296.4kJmol^{-1}$ respectively. The enthalpy of allotropic transformation of monoclinic to rhombic sulphur is :

A. 1.3 kJ

B. $-1.3kJ$

C. $-591.5kJ$

D. 0

Answer: B

39. The standard enthalpies of formation of HCl(g), H(g) and Cl(g) are -92.2, 217.7 and $121.4 kJmol^{-1}$ respectively. The bond dissociation enthalpy of HCl is :

A. $+431.3 kJ$

B. 236.9 kJ

C. $-431.3 kJ$

D. 339.1 kJ

Answer: A

40. The enthalpies of solution of anhydrous $CuSO_4$ and $CuSO_4 . 5H_2O$ are -15.89 and $2.80 kcalmol^{-1}$ respectively. The enthalpy of hydration of $CuSO_4$ to $CuSO_4 . 5H_2O$ is :

A. $-18.69 kcal$

B. 13.09 kcal

C. $-13.9 kcal$

D. 18.69 kcal

Answer: A

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41. The enthalpy of neutralisation of hydration of $CuSO_4$ to $CuSO_4 . 5H_2O$ is :

A. $-69.2 kJ$

B. $-45.0 kJ$

C. $-69.2 kJ$

D. 45.9 kJ

Answer: D

42. For the reaction,

$$2H_2O(g) \rightarrow 2H_2(g) + O_2(g), \Delta H = 571.6kJ$$
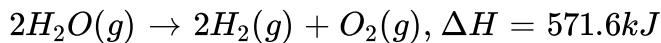
$\Delta_f H^\theta$ of water is:

A. 285.8kJ

B. $-285.8kJ$

C. 1143.2kJ

D. $-1143.2kJ$

Answer: B

43. ΔH for the reaction,

$$SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g) \quad \Delta H = -98.3kJ$$
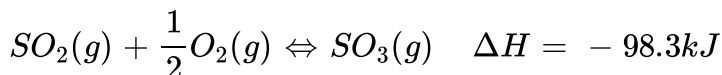
If the enthalpy of formation of $SO_3(g)$ is -395.4kJ, then enthalpy of formation of $SO_2(g)$ is:

A. $-297.1kJ$

B. $493.7kJ$

C. $-493.7kJ$

D. $297.1kJ$

Answer: A

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44. The ΔH^{θ} for the reaction

$4S(s) + 6O_2(g) \rightarrow 4SO_3(g)$ is $-1583.2kJ$. Standard enthalpy of formation of sulphur trioxide is:

A. $-3166.4kJ$

B. $3166.4kJ$

C. $-395.8kJ$

D. 395.8kJ

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45. On combustion carbon forms two oxides CO and CO_2. Heat of formation of CO_2 is -393.5kJ and that of CO is -110.5kJ. Heat of combustion of CO is

A. $-393.5kJ$

B. $-504.0kJ$

C. $-283.0kJ$

D. 283.0kJ

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46. Given C(s)+O_2 (g)→CO 2 (g)+94.2Kcal, H_2 (g)+ 1/2 O_2 (g)→H_2

O(l)+68.3Kcal, CH_4 (g)+2O_2 (g)→CO_2 (g)+2H_2 O(l)+210.8Kcal The heat

of formation of methane in kcal will be:

A. 45.9 kcal

B. 47.8 kcal

C. 20.0 kcal

D. 47.4 kcal

Answer: C

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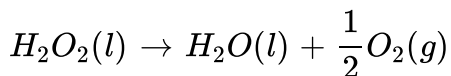**47.** The enthalpy of neutralisation of NH_4OH and HCl is :

A. $57.1 kJmol^{-1}$

B. $< 57.1 kJmol^{-1}$

C. $> 57.1 kJmol^{-1}$

D. zero

Answer: B

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48. The enthalpy of the reaction :

$$H_2O_2(l) \rightarrow H_2O(l) + \frac{1}{2}O_2(g)$$

is $-98.3 KJmol^{-1}$ and the enthalpy of formation of $H_2O(l)$ is $-285.6 kJmol^{-1}$. The enthalpy of formation of $H_2O_2(l)$ is :

A. $-187.3 kJ$

B. 187.3 kJ

C. $-383.9 kJ$

D. 383.9 kJ

Answer: A

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49. Calculate the heat of formation of $PCl_5(s)$ from the following data :

$2P(s) + 3Cl_2(g) \rightarrow 2PCl_3(l)\Delta H = -151.8kcal$

$PCl_3(l) + Cl_2(g) \rightarrow PCl_5(s)\Delta H = -32.8kcal$

A. $-108.7kcal$

B. 108.7 kcal

C. $-184.6kcal$

D. 184.6 kcal

Answer: A

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50. Given that

$2C(s) + 2O_2(g) \rightarrow 2CO_2(g)\Delta H = -787kJ$

$H_2(g) + \dfrac{1}{2}O_2(g) \rightarrow H_2O(l)\Delta H = -286kJ$

$C_2H_2(g) + (2)\dfrac{1}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$
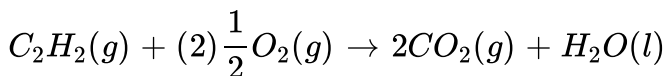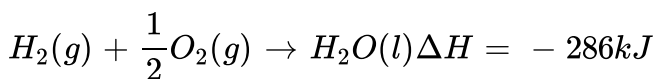
$$\Delta H = -1301 kJ$$

Heat of formation of acetylene is :

A. $-1802 kJ$

B. $+1786 kJ$

C. $-180.2 kJ$

D. $+228 kJ$

Answer: D

51. The heat of neutralisation of strong acid and strong base is 57.0 kJ. The heat released when 0.5 mol of HNO_3 is added to 0.2 mol of NaOH solution is:

A. 57.0 kJ

B. 11.40 kJ

C. 28.5 kJ

D. 34.9 kJ

Answer: B

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52. The heat of combustion of yellow phosphorus and red phosphorus are $-9.91kJ$ and $-8.78kJ$ respectively. The heat of transition of yellow phosphorus to red phosphorus is
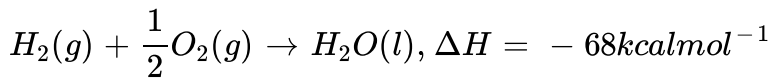
A. $-18.69kJ$

B. $+1.13kJ$

C. $+18.69kJ$

D. $-1.13kJ$

Answer: D

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53. For the reaction :

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H = -68kcalmol^{-1}$$

The heat change for the decomposition of 7.2 g of water is

A. $13.6kcal$

B. $27.2kcal$

C. $54.4kcal$

D. $-34kcal$

Answer: B

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54. When 1000 ml of a 1M solution of sulphuric acid is neutralised by a strong base in dilute solution, the standard enthalpy of neutralisation is

A. $-57.1kJ$

B. $-114.2kJ$

C. $-28.55kJ$

D. $+57.1kJ$

Answer: B

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55. Which of the following values of heat of formation indicates that the product is least stable ?

A. $-94kcal$

B. $-231.6kcal$

C. $+21.4kcal$

D. $+64.8kJ$

Answer: D

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56. In which of the following neutralisation reaction, the heat of neutralisation will be highest ?

    A. NH_4OH and H_2SO_4

    B. HCl and $NaOH$

    C. CH_3COOH and KOH

    D. CH_3COOH and NH_4OH

Answer: B

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57. In the reaction :

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

$\Delta H = 2.8 kJ.\Delta H$ represents

    A. heat of reaction

    B. heat of combustion

C. heat of formation

D. heat of solution

Answer: A

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58. $H_2(g) + I_2 \Leftrightarrow 2HI(g): \Delta H = 12.40 kcal.$

According to this reaction, heat of formation of HI will be
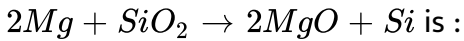
A. 12.4 kcal

B. $-12.4 kcal$

C. $-6.20 kcal$

D. 6.20 kcal

Answer: D

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59. The value of heat of formation of SiO_2 and MgO are 48.24 and 34.7 kJ respectively. The heat of reaction :
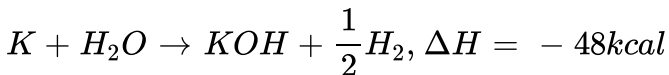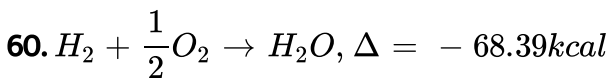
$2Mg + SiO_2 \rightarrow 2MgO + Si$ is :

A. 21.16 kJ

B. $-21.16 kJ$

C. 13.62 kJ

D. $-13.62 kJ$

Answer: A

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60. $H_2 + \dfrac{1}{2}O_2 \rightarrow H_2O, \Delta = -68.39 kcal$

$K + H_2O \rightarrow KOH + \dfrac{1}{2}H_2, \Delta H = -48 kcal$

$KOH + Water \rightarrow KOH(aq), \Delta H = -14 kcal$

The heat of formation of KOH in kcal is :

A. $-34.39 kcal$
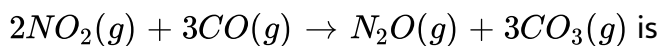
B. 102.39 kcal

C. 34.39 kcal

D. 130.39 kcal

Answer: B

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61. $\Delta_f H^\theta$ of $CO_2(g)$, $CO(g)$, $N_2O(g)$ and $NO_2(g)$ are respectively

-393, -110.81 and 34 $\left(in\ kJmol^{-1}\right)$ at $27°C$.

ΔH (in kJ) for the reaction :

$2NO_2(g) + 3CO(g) \rightarrow N_2O(g) + 3CO_3(g)$ is

A. 836

B. 1460

C. -836

D. -1460

Answer: C

---

62. Given that

$$C + O_2 \rightarrow CO_2 \Delta H^\theta = -xkJ$$

$$2CO + O_2 \rightarrow 2CO_2 \Delta H^\theta = -ykJ$$
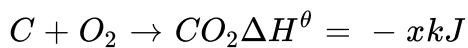
The enthalpy of formation of CO is :

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

B. y - 2x

C. 2x - y

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

Answer: A

63. Calculate ΔH^{θ} for the reaction :

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

Given $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
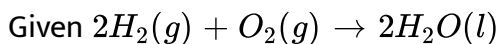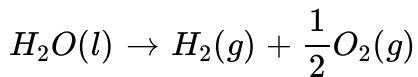
$$\Delta H = -571.6kJ$$

A. 571.6 kJ

B. $-571.6kJ$

C. 285.8 kJ

D. $-285.8kJ$

Answer: C

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64. When 0.5 g of sulphur is burnt to $SO_2 : 4.6kJ$ of heat is liberated.

What is the enthalpy of formation of sulphur dioxide ?

A. $-147.2kJ$

B. $+147.2kJ$

C. $+294.4kJ$

D. $-294.4kJ$

Answer: D

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---

65. Changes in enthalpy for the reaction :

$$2H_2O_2(g) \rightarrow 2H_2O(l) + O_2(g)$$

if heat of formation of $H_2O_2(l)$ and $H_2O(l)$ are $-188kJmol^{-1}$ and $-286kJmol^{-1}$ respectively is
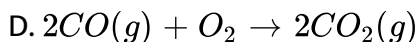
A. $-196kJmol^{-1}$

B. $+196kJmol^{-1}$

C. $+948kJmol^{-1}$

D. $-948kJmol^{-1}$

Answer: A

66. For which one of the following equations is $\Delta_r H^\theta$ equal to $\Delta_f H^\theta$ for the product ?

A. $N_2(g) + O_3(g) \rightarrow N_2O_3(g)$

B. $CH_4(g) + 2Cl_2(g) \rightarrow CH_2Cl_2(g) + 2HCl(g)$

C. $Xe(g) + 2F_2(g) \rightarrow XeF_4(g)$

D. $2CO(g) + O_2 \rightarrow 2CO_2(g)$
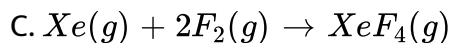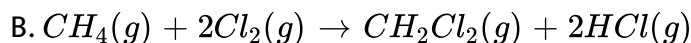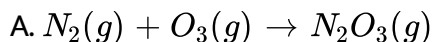
Answer: C

67. Consider the following reaction :

(A) $H^+(aq) + OH^-(aq) = H_2O(l) : \Delta H = -X_1 kJmol^{-1}$

(B) $H_2(g) + \dfrac{1}{2}O_2(g) = H_2O(l) : \Delta H = -X_2 kJmol^{-1}$

(C) $CO_2(g) + H_2(g) = CO(g) + H_2O(l) : \Delta H = -X_3 kJmol^{-1}$

(D) $C_2H_2(g) + \dfrac{5}{2}O_2(g) = 2CO_2 + H_2O(l) : \Delta H = +X_4 kJmol^{-1}$
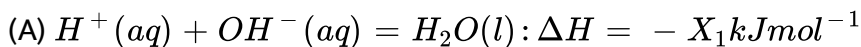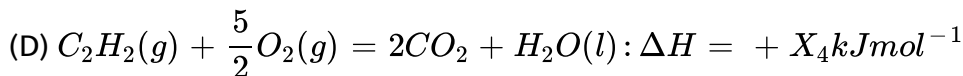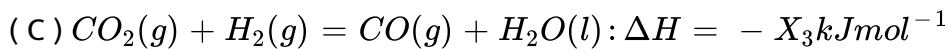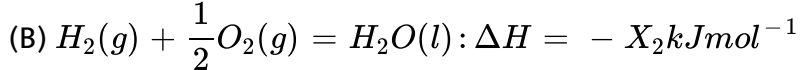
Enthalpy of formation of $H_2O(l)$ is :

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

B. $-X_2 kJmol^{-1}$

C. $+X_3 kJmol^{-1}$

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

Answer: B

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68. The enthalpy of formation of NH_3 is $-46kJ/mol$ The enthalpy change for reaction :

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ is :
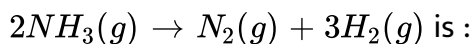
A. $+23kJ$

B. $+92kJ$

C. $+46kJ$

D. $+184kJ$

Answer: B

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69. The enthalpy changes at $25°C$ in successive breaking of O - H bonds of water are :

$H_2O(g) \rightarrow H(g) + OH(g)\Delta H = 498kJmol^{-1}$

$OH(g) \rightarrow H(g) + O(g)\Delta H = 428kJmol^{-1}$
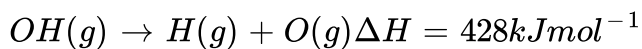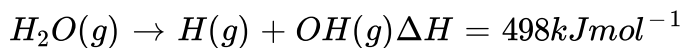
The bond enthalpy of the O-H bond is :

A. $498kJmol^{-1}$

B. $463kJmol^{-1}$

C. $428kJmol^{-1}$

D. $70kJmol^{-1}$

Answer: B

---

70. Calculate the heat of the reaction :

$$CH_2 = CH_2(g) + H_2(g) \rightarrow CH_3CH_3(g)$$
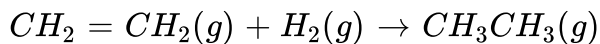
given that bond energy of C-C, C=C, C-H and H-H is 80, 145, 98 and 103 kcal.

    A. $-28 kcal mol^{-1}$

    B. $-5.6 kcal mol^{-1}$

    C. $-2.8 kcal mol^{-1}$

    D. $-56 kcal mol^{-1}$

Answer: A

71. If the bond energies of H-H, Br-Br and H-Br are 433, 192 and 364 kJ mol^{-1} respectively, then ΔH° for the reaction :

$H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$ is
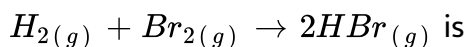
A. $+103kJ$

B. 261 kJ

C. $-103kJ$

D. $-261kJ$

Answer: C

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72. From the following bond energies :

$H - H$ bond energy : $431.37 kJmol^{-1}$
$C = C$ bond energy : $606.10 kJmol^{-1}$
$C - C$ bond energy : $336.49 kJmol^{-1}$
$C - H$ bond energy : $410.50 kJmol^{-1}$

calculate the bond energy of the following reaction :

$$H - \underset{\underset{H}{|}}{C} = \underset{\underset{H}{|}}{C} - H + H - H \rightarrow H - \underset{\underset{|}{H}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{|}{H}}{\overset{\overset{H}{|}}{C}} - H$$
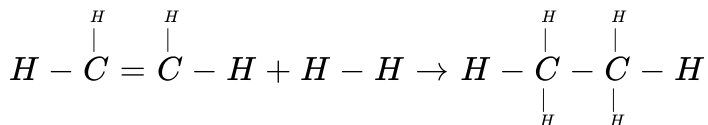
A. $-243.6 kJ/mol$

B. $-120.0 kJ/mol$

C. 553.0 kJ//mol

D. 1523.6 kJ//mol

Answer: B

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73. Entropy of the universe is

A. tends towards a maximum

B. tends towards a minimum

C. tends to be zero

D. remains constant

Answer: A

---

74. Entropy change for an adiabatic reversible process is :

A. zero

B. $+ve$

C. $-ve$

D. negative or zero

Answer: A

---

75. Which of the following processes is not accompanied by increase of entropy ?

A. dissolution of NH_4Cl in water

B. burning of rocket fuel

C. sublimation of dry ice

D. condensing steam

Answer: D

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76. Which of the following conditions is not favourable for the feasibility

of a process ?

A. $\Delta H = -ve, T\Delta S = -ve$ and $T\Delta S < \Delta H$

B. $\Delta H = +ve, T\Delta S = +ve$ and $T\Delta S > \Delta H$

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

D. $\Delta H = +ve, T\Delta S = +ve$ and $\Delta H > T\Delta S$

Answer: D

77. In which of the following cases, the reaction is spontaneous at all temperatures ?

A. $\Delta H > 0, \Delta G > 0$

B. $\Delta H < 0, \Delta G > 0$

C. $\Delta H < 0, \Delta G < 0$

D. $\Delta H > 0, \Delta G < 0$

Answer: B

78. For an endothermic reaction, ΔS is positive. The reaction is :

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

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

C. feasible at all temperatures

D. not feasible at all

Answer: A

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79. When potessium chloride is dissovled in water,

A. entropy increases

B. entropy decreases

C. entropy increases and then decreases

D. free energy increases

Answer: A

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80. All the naturally occuring processes proceed spontaneously in a direction which leads to

A. Decrease of entropy

B. Increase of enthalpy

C. Increase of free energy

D. Decrease of free energy

Answer: D

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81. For a spontaneous reaction, ΔG should be :

A. positive

B. negative

C. equal to zero

D. may be positive or negative

Answer: B

82. When a solid changes into liquid, the entropy :

    A. increases

    B. remains the same

    C. decreases

    D. becomes zero

Answer: A

83. Entropy is a measure of :

    A. disorder

B. internal energy

C. efficiency

D. useful work done by the system

Answer: A

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84. When a solid is coverted directly into gaseous state, the process is called sublimation. The entropy change during the process is :

A. zero

B. negative

C. positive

D. may be negative

Answer: C

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85. Which of the following processes is accompanied by decrease in entropy ?

A. Evaporation of water

B. Sublimation of dry ice

C. Melting of ice

D. Condensing steam

Answer: D

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86. Free energy is related to enthalpy and entropy changes as :

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

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

C. $\Delta G = \dfrac{\Delta H - \Delta S}{T}$

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

Answer: A

---

87. For which of the following reactions, ΔS is not positive ?

A. $I_2(s) \rightarrow I_2(g)$

B. $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$

C. $2O_3(g) \rightarrow 3O_2(g)$

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

Answer: B

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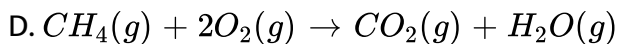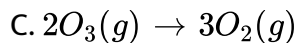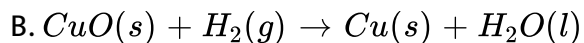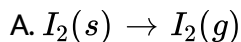
88. For an equilibrium state,

A. $\Delta H > 0$

B. $\Delta G > 0$

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

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

Answer: C

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89. The standard free energy changes $\left(\Delta G^\theta\right)$ is related to equilibrium constant (K) as

A. $\Delta G^\theta = -2.303RT \ln K$

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

C. $\Delta G^\theta = -2.303RT \log K$

D. $\Delta G^\theta = RT \log K$

Answer: C

90. The units of entropy are :

    A. $Jmol^{-1}$

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

    C. Jg^{-1}

    D. $JKmol^{-1}$

Answer: B

91. In an electrochemical cell, if E is the e.m.f. of the cell involving n mole of electrons, then ΔG° is :

    A. $\Delta G^\theta = nFE^\theta$

    B. $\Delta G^\theta = -nFE^\theta$

C. $E^{\theta} = nF\Delta G^{\theta}$

D. $\Delta G^{\theta} = \dfrac{nF}{E^{\theta}}$

Answer: B

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92. For a spontaneous endothermic reaction :

A. $\Delta G > 0$

B. $\Delta G = 0$

C. $\Delta H < 0$

D. $\Delta S > \dfrac{\Delta H}{T}$

Answer: D

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93. The sign of ΔG for the process of melting of ice at 260 K is :

A. $\Delta G = 0$

B. $\Delta G < 0$

C. $\Delta G > 0$

D. $\Delta G \leq 0$

Answer: C

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94. The enthalpy of vaporisation of a substance is $8400 Jmol^{-1}$ and its boiling point is $-173°C$. The entropy change for vaporisation is :

A. $84 Jmol^{-1}K^{-1}$

B. $21 Jmol^{-1}K^{-1}$

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

D. $12 Jmol^{-1}K^{-1}$

Answer: A

95. If equilibrium constant K is 10^3, the ΔG^θ for the reaction at 300 K is (assume $R = 8.314 JK^{-1}mol^{-1}$) :

A. $-16.582 kJ$

B. 16.582 kJ

C. 165.82 kJ

D. 1658.2 kJ

Answer: A

96. The enthalpy of vaporisation of a compound AB a its boiling point $(127°C)$ is $6.4 kJmol^{-1}$. Its entropy of vapourisation is :

A. $2.56kJKmol^{-1}$

B. $16JKmol^{-1}$

C. $16 \times 10^{-3}JKmol^{-1}$

D. $1.6 \times 10^3kJKmol^{-1}$

Answer: B

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97. The equilibrium constant for a reaction is 10. ΔG^θ will be

$R = 8JK^{-1}mol^{-1}$, T = 300 K)

A. $-5527kJmol^{-1}$

B. $-5.527kJmol^{-1}$

C. $-55.27kJmol^{-1}$

D. $+5.527kJmol^{-1}$

Answer: B

98. ΔH (vap) for water is $40.7 kJmol^{-1}$. The entropy of vaporisation of water is :

    A. $-40.7 kJmol^{-1}K^{-1}$

    B. $407 Jmol^{-1}K^{-1}$

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

    D. $722 Jmol^{-1}$

Answer: C

99. The enthalpy of vaporisation of water is $186.5 kJmol^{-1}$. The entropy of its vaporisation will be :

    A. $2.0 JK^{-1}$

B. $200JK^{-1}$

C. $0.5JK^{-1}$

D. $1.5JK^{-1}$

Answer: C

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100. For the reaction at 298 K :

$$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta H^\circ = -282.8kJ$$
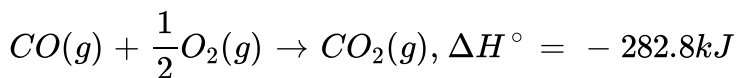
Standard entropies (in $JK^{-1}mol^{-1}$) :

$CO_2(g) = 213.6 CO(g) = 197.6$ and $O_2(g) = 205.0 \Delta_r G^\circ$ for the reaction $(kJmol^{-1})$

A. -306.02

B. -257.81

C. 306.02

D. -157.03

Answer: B

---

101. For the process : $CO_2(s) \rightarrow CO_2(g)$

A. Both ΔH and ΔS are +ve

B. ΔH is -ve, ΔS is +ve

C. ΔH is +ve, ΔS is -ve

D. Both ΔH and ΔS are -ve

Answer: A

---

102. Entropy change for an isothermal expansion of one mole of an ideal gas from volume V_1 to V_2 is :

A. $R\ln\dfrac{V_2}{V_1}$

B. $2.303R\ln\dfrac{V_2}{V_1}$

C. $R\ln\dfrac{V_1}{V_2}$

D. $R\ln(V_2 - V_1)$

Answer: A

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103. For a reaction to be spontaneous at all temperatures

A. ΔG and ΔH should be negative

B. $\Delta H = \Delta G = 0$

C. ΔG and ΔH should be positive

D. $\Delta H < \Delta G$

Answer: A

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104. The free energy change $\Delta G = 0$, when

A. the system is at equilibrium

B. catalyst is added

C. reactants are initially mixed thoroughly

D. the reactants are completely consumed

Answer: A

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105. For a reaction to occur spontaneously

A. ΔS must be negative

B. $(\Delta H - T\Delta S)$ must be negative

C. $(\Delta H + T\Delta S)$ must be negative

D. ΔH must be negative

Answer: B

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106. The enthalpy and entropy of a reaction are $-5.0 kJmol^{-1}$ and $-20JK^{-1}mol^{-1}$ respectively and independent of tempareture. The highest temperature upto which the reaction is feasible is :

A. 250 K

B. 260 K

C. 275 K

D. 300 K

Answer: A

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107. The free energy change for a reaction is zero when

A. The reactants are initially mixed

B. A catalyst is added

C. The system is at equilibrium

D. The reactants are completely consumed

Answer: C

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108. The change in entropy of an ideal gas during a reversible isothermal

expansion is

A. negative

B. positive

C. zero

D. infinite

Answer: B

109. Considering entropy (s) as a thermodynamic parameter, the criterion for the spontaneity of any process is

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

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

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

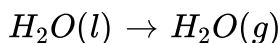D. $\Delta S_{system} + \Delta S_{surroundings} > 0$

Answer: D

110. Identify the correct statement for change of Gibb's energy for a system (ΔG_{system}) at constant temperature and pressure :

A. If $\Delta G_{system} = 0$, the system has attained equilibrium

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

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

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

Answer: A

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111. Entropy changes for the process

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

at normal pressure and 274 K are given below

$\Delta G_{system} = -22.13, \Delta S_{surroundings} = +22.05$

Then process is non spontaneous because

A. ΔG_{system} is -ve

B. $\Delta G_{surrounding}$ is +ve

C. $\Delta S_{universe}$ is -ve

D. $\Delta G_{system} \neq \Delta S_{\text{surrounding}}$

Answer: C

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112. The second law of thrmodynamics says that in a cyclic process,

A. work cannot be converted into heat

B. heat cannot be converted into work

C. work cannot be completely converted into heat

D. heat cannot be completely converted into work

Answer: D

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113. A reaction cannot take place spontaneously at any temperature where

    A. both ΔH and ΔS are positive

    B. both ΔH and ΔS are negative

    C. ΔH is negative and ΔS is positive

    D. ΔH is positive and ΔS is negative

Answer: D

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114. Pick out the wrong statement.

    A. Standard free energy of formation of all elements is zero

    B. A process accompanied by decrease in entropy is spontaneous under certain conditions

C. The entropy of a perfectly crystalline substance at absolute zero is

   zero

D. A process that leads to increase in free energy will be spontaneous

Answer: D

115. The values of ΔH and ΔS for the reaction.
$C(\text{graphite}) + CO_2(g) \rightarrow 2CO(g)$ are 170 kJ and $170 JK^{-1}$, respectively. This reaction will be spontaneous at :

A. 910 K

B. 1110 K

C. 510 K

D. 710 K

Answer: B

116. Which of the following demonstrates a decrease in entropy ?

A. Dissolving a solid into solution

B. An expanding universe

C. Burning a log in a fireplace

D. Raking up leaves into a trash bag

Answer: D

117. A certain reaction is at equilibrium at $82°C$ and the enthalpy change for the reaction is 21.3 kJ. The value of ΔS (in $JKmol^{-1}$ for the reaction is

A. 55.0

B. 60.0

C. 68.5

D. 120.0

Answer: C

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118. Standard entropies of X_2, Y_2 and XY_3 are 60, 40 and $50 JK^{-1}$

respectively

$\frac{1}{2}X_2 + \frac{3}{2}Y, \Delta H = -30kJ$ to be at equilibrium, the temperature

should be :

A. 1250 K

B. 500 K

C. 750 K

D. 1000 K

Answer: B

---

119. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^(-1) at $27°C$, the entropy change for the process would be :

A. $10 Jmol^{-1}K^{-1}$

B. $1.0 Jmol^{-1}K^{-1}$

C. $0.1 mol^{-1}K^{-1}$

D. $100 Jmol^{-1}K^{-1}$

Answer: D

---

120. The standard Gibbs free energies $(\Delta_f G°)$ for the formation of $SO_2(g)$ and $SO_3(g)$ are -300.0 and $-371.0 kJmol^{-1}$ at 300 K

respectively. ΔG for the reaction.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is
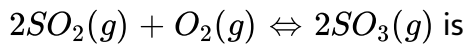
A. 1342 kJ

B. $- 142kJ$

C. $- 71kJ$

D. $- 671kJ$

Answer: A

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Multiple Choice Questions Level Ii

1. For which of the following reactions, ΔH is greater than ΔU ?

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

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

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

D. $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(aq)$
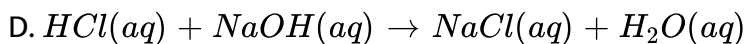
Answer: C

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2. A sample of gas changes from p_1, V_1 and p_2. V_2 and T_2 by one path and then back to p_1, V_1 and T_1. ΔU for the process is :

A. Infinite

B. > 0

C. < 0

D. equal to 0

Answer: D

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3. An endothermic reaction is allowed to occur very rapidly in the air. The temperature of the surrounding air

    A. remains constant

    B. decreases

    C. increases

    D. may increase or decrease

Answer: B

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4. Under which of the following conditions is the relation $\Delta H = \Delta U + p\Delta V$ valid for a closed system ?
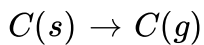
    A. constant pressure

    B. constant temperature

    C. constant temperature and constant pressure

D. constant temperature, pressure and composition

Answer: C

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5. The enthalpy change for the process :

$$C(s) \rightarrow C(g)$$

corresponding to enthalpy of

    A. fusion

    B. Sublimation

    C. combustion

    D. vaporisation

Answer: B

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6. For the reversible vaporisation of water at 373 K and 1 atmosphere pressure, ΔG is equal to

A. ΔH

B. ΔS

C. zero

D. $\dfrac{\Delta H}{T}$

Answer: C

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7. Calculate the heat required to make 6.4 kg of CaC_2 from CaO(s) and C(s) from the reaction :

$CaO(s) + 3C(s) \rightarrow CaCl_2(s) + CO(g)$ given   that

$\Delta_f H^\theta(CaO) = -151.6 kcal.$ $\Delta_f H^\theta(CaC_2) = -14.2 kcal.$

$\Delta_f H^\theta(CO) = -26.4 kcal$

A. 5624 kcal

B. $1.1 \times 10^4 kcal$

C. 86.24×10^3

D. 1100 kcal

Answer: B

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8. Four grams of helium is expanded from 1 atm to one-tenth of its origiinal pressure at $30°C$. Change in entropy (assuming ideal gas behaviour) is :

A. $38.3JK^{-1}$

B. $76.6JK^{-1}$

C. $19.15JK^{-1}$

D. $100JK^{-1}$

Answer: C

9. The entropy change of the conversion of 1 mol of α- tin (at $13°C$, 1 atm) to 1 mol of β- tin($13°$, 1 atm). If enthalpy of transition is $2.095 kJmol^{-1}$ is :

A. $7.32 Jmol^{-1}K^{-1}$

B. $14.62 JK^{-1}mol^{-1}$

C. $56.3 Jmol^{-1}K^{-1}$

D. 0

Answer: A

10. The following data is known about the melting of a compoun AB. $\Delta H = 9.2 kJmol^{-1}$, $\Delta S = 0.008 kJK^{-1}mol^{-1}$. Its melting point is :

A. 736 K

B. 1050 K

C. 1150 K

D. $1150°C$

Answer: C

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11. For a reaction,

$X + Y \rightarrow Z$

there is no entropy charge. Enthaply change for the reaction is $100 Jmol^{-1}$. ΔG is

A. $-100 Jmol^{-1}$

B. $100 Jmol^{-1}$

C. 0

D. Infinite

Answer: B

---

12. The difference between heats of reaction at constant pressure and constant volume for the reaction.

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

A. $-7.43kJ$

B. $+3.72kJ$

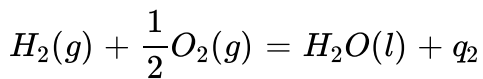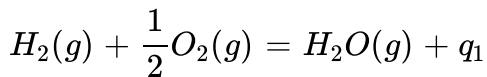C. $-3.72kJ$

D. 7.43 kJ

Answer: A

13. Given :

$$H_2(g) + \frac{1}{2}O_2(g) = H_2O(g) + q_1$$

$$H_2(g) + \frac{1}{2}O_2(g) = H_2O(l) + q_2$$

The enthalpy of vaporisation of water is equal to

A. $q_1 + q_2$

B. $q_1 - q_2$

C. $q_2 - q_1$

D. $q_1 q_2$

Answer: C

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14. If $CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O + xkJ$

$H^+ + OH^- \rightarrow H_2O + ykJ$

The enthalpy change for the reaction :

$CH_3COOH \rightarrow CH_3COO^- + H^+$ is
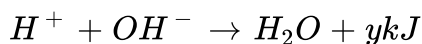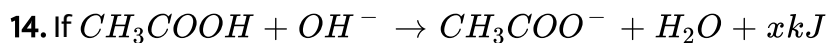
A. x + y

B. x - y

C. y - x

D. $x - y/2$

Answer: C

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15. The heat of neutralisation of HCl and NaOH is 57.3 kJ mol^{-1}. The amount of heat liberated when 0.25 mol of HCl reacts with 1 mol of NaOH is :

A. 57.3 kJ

B. 14.325 kJ

C. 28.65 kJ

D. 114.6 kJ

Answer: C

16. Given that $O(g) + e^- \rightarrow O^-(g) \Delta H = -142 kJmol^{-1}$

$O(g) + 2e^- \rightarrow O^{2-}(g)\Delta H = +712 kJmol^{-1}$

The heat change for the reaction

$O^-(g) + e^- \rightarrow O^{2-}(g)$ is :

A. $-570 kJ$

B. 570 kJ

C. $+854 kJ$

D. $-854 kJ$

Answer: C

17. Equal volumes of 1 M HCl and H_2SO_4 are neutralised by dil NaOH solution and x kJ and y kJ of heat are librated respectively. Which of the following is true ?

    A. x = y

    B. $x = \dfrac{1}{2}y$

    C. x = 2y

    D. None of these.

Answer: B

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18. For an ideal gas, the Joule Thomson co-efficient is equal to

    A. 1

    B. 0

    C. 2

D. infinity

Answer: B
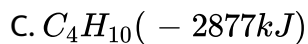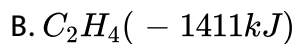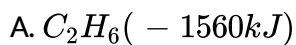
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19. The enthalpies of combustion of some fuels are given below. Which of these has lowest efficiency as fuel per gram ?

A. $C_2H_6(-1560kJ)$

B. $C_2H_4(-1411kJ)$

C. $C_4H_{10}(-2877kJ)$

D. $CH_4(-890.4kJ)$
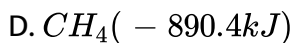
Answer: C

20. Which of the following statements/relationships is not correct ?

A. In an exothermic reaction, enthalpy of products is less than that of reactants.

B. A reaction for which $\Delta H^{\theta} < 0$ and $\Delta S^{\theta} > 0$ is spontaneous at all temperatures.

C. ΔH is less than, ΔE for the reaction :

$$C(s) + \frac{1}{2}O_2(g) \to CO(g)$$
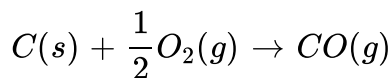
D. $\Delta_{vap}H = \Delta_{sub}H - \Delta_{fus}H$

Answer: C

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21. The maximum work obtained by an isothermal reversible expansion of 1 mol of an ideal gas at $27°C$ from 2.24 to 22.4L is (R = 2 cal)

A. 1381.8 cal

B. 600 cal

C. 138.18 cal

D. 690.9 cal

Answer: A

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22. Which of the following salts will have maximum cooling effect when 0.5 mole of the salt is dissolved in same amount of water. Integral heat of solution at 298 K is given for each salt ?

A. $KNO_3 \left(\Delta H = 35.4 kJmol^{-1} \right)$

B. $NaCl \left(\Delta H = 5.35 kJmol^{-1} \right)$

C. $HBr \left(\Delta H = -83.3 kJmol^{-1} \right)$

D. $KOH \left(\Delta H = -55.6 kJmol^{-1} \right)$

Answer: A

23. One mole of ice is coverted into water at 273 K. The entropies of $H_2O(s)$ and $H_2O(l)$ are 38.20 and $60.01 Jmol^{-1}K^{-1}$ respectively. The enthaply change for the conversion is

A. $59.54 Jmol^{-1}$

B. $5954 Jmol^{-1}$

C. $595.4 Jmol^{-1}$

D. $320.6 Jmol^{-1}$

Answer: B

24. The molar heat of vaporisation for water is $9.72 kcalmol^{-1}$. The amount of heat change when 45 g of water condense is :

A. 437.4 kcal

B. 24.3 kcal

C. 243 kcal

D. 3.89 kcal

Answer: B

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25. Which of the following properties of a system undergoing change at a constant temperature and pressure is a measure of the maximum useful work that the system can do ?

A. ΔG

B. ΔS

C. ΔH

D. P ΔV

Answer: A

---

26. Two objects are said to be in thermal equilibrium if they have same

    A. kinetic energy

    B. temperature

    C. potential energy

    D. internal energy

Answer: B
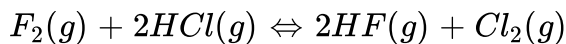
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27. An isolated system is that system in which

    A. There is no exchange of energy with the surroundings

B. There is exchange of mass and energy with the surroundings

C. There is no exchange of mass and energy with the surroundings

D. There is exchange of mass with surroundings.

Answer: D

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28. For the reaction :

$$F_2(g) + 2HCl(g) \Leftrightarrow 2HF(g) + Cl_2(g)$$

ΔH^θ at $25°C$ is $= -84.4kcalmol^{-1}$

$\Delta_f H^\theta(HF) = -64.2kcalmol^{-1}$

$\Delta_f H^\theta$ for HCl(g) per gram is :

A. $-0.603kcalg^{-1}$

B. $0.603kcalg^{-1}$

C. $0.0603kcalg^{-1}$

D. $6.03kcalg^{-1}$

Answer: A

---

29. M is a metal which forms an oxide, M_2O and $\frac{1}{2}M_2O(s) \rightarrow M(s) + \frac{1}{4}O_2(g), \Delta H = 90kJmol^{-1}$
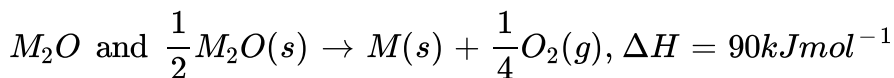
When a sample of the metal M reacts with 1 mole of $O_2(g)$ to form M_2O, ΔH for the reaction is :

A. $+180kJ$

B. $-180kJ$

C. $-360kJ$

D. 360 kJ

Answer: C

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

A. $\Delta H > \Delta U$

B. $\Delta H < \Delta U$

C. $\Delta H = \Delta U$

D. Not definite

Answer: B

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31. Latent heat of vaporisation of a liquid at 500 K and 1 atm pressure is $10 kcal/mol$. What will be the change in internal energy (ΔU) of 3 mol of liquid at the same temperature ?

A. 13.0 kcal

B. $-13.0 kcal$

C. 27.0 kcal

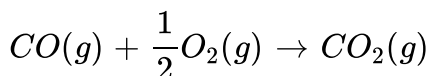D. $-27.0 kcal$

Answer: C

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32. At constant T and P which one of the following statements is correct

for the reaction :

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

A. $\Delta H = \Delta U$

B. $\Delta H < \Delta U$

C. $\Delta H > \Delta U$

D. ΔH is independent of the physical state of the reactant of that

compound

Answer: B

---

33. If $S + O_2 \rightarrow SO_2, \Delta H = -298.2 kJ$

$SO_2 + \dfrac{1}{2}O_2 \rightarrow SO_3, \Delta H = -98.2 kJ$

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

$H_2 + \dfrac{1}{2}O_2 \rightarrow H_2O, \Delta H = -287.3 kJ$
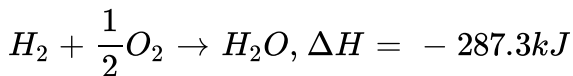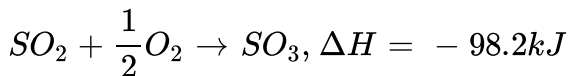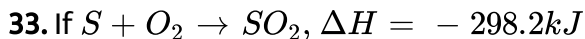
the enthalpy of formation of H_2SO_4 at 298 K will be

A. $-433.7 kJ$

B. $-650.3 kJ$

C. $+320.5 kJ$

D. $-813.9 kJ$

Answer: D

34. The latent heat of vaporisation of water at $100°$ is $2257\dfrac{kJ}{kg}$. The ΔH

for the process

$H_2O(g) \rightarrow H_2O(l)$ is very nearly

    A. $+2257J$

    B. $-2257J$

    C. $+40.7kJ$

    D. $-40.7kJ$

Answer: D

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35. If ΔH and ΔU are the changes in the enthalpy and internal energy

when a liquid is converted into its vapours at temperature T, then :

    A. $\Delta H - \Delta U = 0$

    B. $\Delta H - \Delta U = 22.4kJ/mol$

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

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

Answer: C

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36. One mole of methannol when burnt in oxygen gives out $723kJmol^{-1}$ heat. If one mole of oxygen is used, what will be the amount of heat evolved ?

A. 723 kJ

B. 964 kJ

C. 482 kJ

D. 241 kJ

Answer: C

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37. $S + \dfrac{3}{2}O_2 \to SO_3 + 2x\,kcal$

$SO_2 + \dfrac{1}{2}O_2 \to SO_3 + y\,kcal$
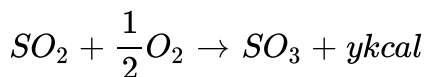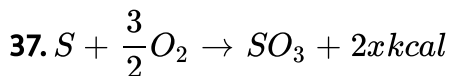
Find out the heat of formation of SO_2 :

    A. (2x - y)

    B. (2x + y)

    C. (x + y)

    D. $2x\,/\,y$

Answer: A

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38. The enthalpy of formation of two compounds A and B are $-84kJ$ and $-156kJ$ respectively. Which one of the following statements is correct ?

    A. A and B are endothermic compounds

B. A is more stable than B

C. A is less stable than B

D. Both A and B are unstable

Answer: C

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39. For a reaction at equilibrium, the partial pressure of B is found to be one fourth of the partial pressure of A. The value of ΔG^{θ} of the reaction $A \rightarrow B$ is

A. $- RT \log 4$

B. $2.303 RT \log 4$

C. $- 2.303 RT \dfrac{\log 1}{4}$

D. $2.303 R \log 4$

Answer: B

40. When an ideal gas is suddenly allowed to expand adiabatically into an evacuated container, then

A. $\Delta S = 0$

B. $\Delta G = 0$

C. $\Delta U = 0$

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

Answer: C

41. In which case of mixing of a strong acid and a strong base each of 1 M concentration. Temperature increase is the highest ?

A. 15 ml acid and 40 ml alkali

B. 10 ml acid and 25 ml alkali

C. 20 ml acid and 20 ml alkali

D. 40 ml acid and 20 ml alkali

Answer: C

---

42. The dissociation energy of CH_4 and C_2H_6 are respectively 1508 and

$2594kJmol^{-1}$ respectively. The bond energy of C-C bond is

A. $332kJmol^{-1}$

B. $316kJmol^{-1}$

C. $806kJmol^{-1}$

D. $320kJmol^{-1}$

Answer: A

43. Standard heat of formation of CH_4. CO_2 and $H_2O(l)$ are -76.2, -394.8 and $-241.6 kJmol^{-1}$. Amount of heat evolved by burning $1m^3$ of CH_4 measured at normal conditions is

A. $3.579 \times 10^6 kJ$

B. $3.579 \times 10^4 kJ$

C. $6.240 \times 10^4 kJ$

D. $6.240 \times 10^7 kJ$

Answer: B

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44. Standard molar enthalpy of formation of CO_2 is equal to

A. zero

B. standard molar enthalpy of combustion

C. the sum of standard molar enthalpies of formation of CO and O_2

D. the standard molar enthalpy of combustion of carbon (graphite)

Answer: D

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45. The enthalpy change in freezing 1 g of water (

ΔHfusion $= 6.0 kJmol^{-1}$) will be

A. $-6000.0 J$

B. $-333 J$

C. 333.33 J

D. 60.0 J

Answer: C

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46. For the reaction :
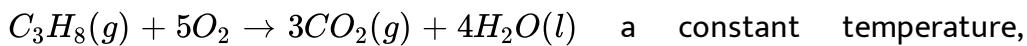
$$C_3H_8(g) + 5O_2 \rightarrow 3CO_2(g) + 4H_2O(l)$$ a constant temperature, $\Delta H - \Delta U$ is

A. $+RT$

B. $-3RT$

C. $+3RT$

D. $-RT$

Answer: B

47. For a reaction to occur spontaneously

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

B. $T\Delta S > \Delta H$ and ΔH is +ve and ΔS is -ve

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

D. $T\Delta S = \Delta H$ and both ΔH and ΔS are +ve
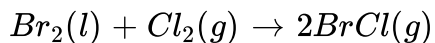
Answer: C

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

    A. Exothermic and increasing disorder

    B. Exothermic and decreasing disorder

    C. Endothermic and increasing disorder

    D. Endothermic and decreasing disorder

Answer: A

49. The enthalpy and entropy change for the reaction :

$$Br_2(l) + Cl_2(g) \rightarrow 2BrCl(g)$$
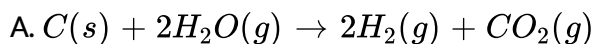
are $30 kJmol^{-1}$ and $105 JK^{-1}$ respectively. The temperature at which the reaction will be in equilibrium is :
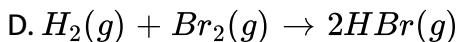
A. 273 K

B. 450 K

C. 300 K

D. 285.7 K

Answer: D

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50. Assume each reaction is carried out in an open container. For which reaction will be $\Delta H = \Delta U$?

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

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

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

D. $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$
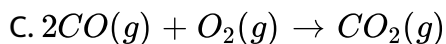
Answer: D

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51. Given that bond energies H-H and Cl-Cl are $430 kJmol^{-1}$ and $240 kJmol^{-1}$ respecively and $\Delta_f H$ for HCl is $-90 kJmol^{-1}$. Bond enthalpy of HCl is :

A. $380 kJmol^{-1}$

B. $425 kJmol^{-1}$

C. $245 kJmol^{-1}$

D. $290 kJmol^{-1}$

Answer: B

52. Sodium chloride is soluble in water not in benzene because

A.

$\Delta H_{\text{hydration}} < \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{solvation}} > \Delta H_{\text{lattice energy i}}$

B.

$\Delta H_{\text{hydration}} > \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{solvation}} < \Delta H_{\text{lattice energy i}}$

C.

$\Delta H_{\text{hydration}} = \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{solvation}} < \Delta H_{\text{lattice energy i}}$

D.

$\Delta H_{\text{hydration}} < \Delta H_{\text{lattice energy in water}}$ and $\Delta H_{\text{solvation}} = \Delta H_{\text{lattice energy i}}$

Answer: B

53. Calculate the work done when 1 mol of an ideal gas is compressed reversible from 1 bar to 4 bar at a constant temperature of 300 K.
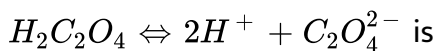
A. 4.01 kJ

B. $-8.02 kJ$

C. 18.02 kJ

D. 3.458 kJ

Answer: D

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54. The enthalpy of neutralisation of oxalic acid by a strong base is $-25.4 kcal/mol$. The enthapy of neutralisation of a strong acid and strong base is -13.7 kcal/equiv. The enthaply of dissociation of $H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-}$ is

A. $1.0 kcal/mol$

B. $2.0 kcal/mol$

C. $18.55 kcal/mol$

D. $11.7 kcal/mol$

Answer: B

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55. The heats of atomisation of $PH_3(g)$ and $P_2H_4(g)$ are $954 kJmol^{-1}$ and $1485 kJmol^{-1}$ respectively. The P-P bond energy in $kJmol^{-1}$ is

A. 213

B. 426

C. 318

D. 1272

Answer: A

56. Given that $dU = TdS - PdV$ and $H = U + PV$. Which one of the following relations is true ?

    A. $dH = TdS + VdP$

    B. $dH = SdT + VdP$

    C. $dH = -SdT + VdP$

    D. $dH = dU + PdV$

Answer: A

57. The values of ΔH and ΔS for the reaction. $C(\text{graphite}) + CO_2(g) \rightarrow 2CO(g)$ are 170 kJ and $170 JK^{-1}$, respectively. This reaction will be spontaneous at :

A. 910 K

B. 1110 K

C. 510 K

D. 710 K

Answer: B

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58. Which of these species has a standard enthalpy of formation equal to zero ?

A. $F_2(g)$

B. F(g)

C. HF(aq)

D. $F^-(aq)$

Answer: A

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

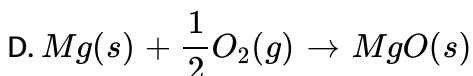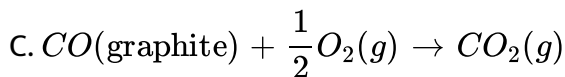A. $q = 0, \Delta T \neq 0, w = 0$

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

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

A. $\dfrac{1}{2}C(\text{graphite}) + \dfrac{1}{2}O_2(g) \rightarrow \dfrac{1}{2}CO_2(g)$

B. $C(\text{graphite}) + \dfrac{1}{2}O_2(g) \rightarrow CO_2(g)$

C. $CO(\text{graphite}) + \dfrac{1}{2}O_2(g) \rightarrow CO_2(g)$

D. $Mg(s) + \dfrac{1}{2}O_2(g) \rightarrow MgO(s)$
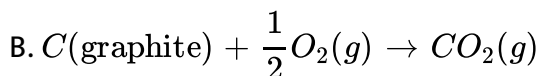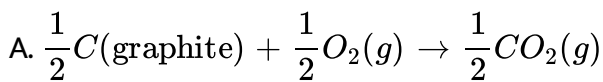
Answer: B

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61. Standard enthaply of vaporisation $\Delta_{vap}H^{\theta}$ for water at $100°C$ is $40.66 kJmol^{-1}$. The internal energy of vapourisation of water at $100°C$ (in $kJmol^{-1}$) is :

A. $+40.66$

B. $+37.56$

C. -43.76

D. $+43.76$

Answer: B

62. 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 presence of reactants in a closed vessel made up of copper is

   an example of a closed system

   D. The presence of reactants in a thermos flask or any other closed

   insulated vessel is an example of a closed system

Answer: C

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

    A. reduced to half

    B. be doubled

    C. remain constant

    D. increased four times

Answer: C

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64. $\Delta_f U^\circ$ of formation of $CH_4(g)$ at certain temperature is $-393kJmol^{-1}$. The value of $\Delta_f H^\circ$

    A. zero

    B. $< \Delta_f U^\circ$

C. $> \Delta_f U^\circ$

D. equal to $\Delta_f U^\circ$

Answer: B

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65. 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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66. 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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67. 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

---

68. Which of the following is not correct ?

A. ΔG is zero for a reversible reaction
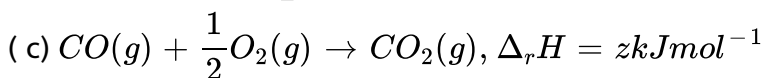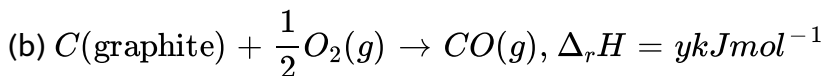
B. ΔG is positive for a spontaneous reaction

C. ΔG is negative for a spontaneous reaction

D. ΔG is positive for a non-spontaneous reaction

Answer: B

69. On the basis of thermochemical equation (a), (b) and (c), which of the algebric relationship is correct.

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

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

(c) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$, $\Delta_r H = zkJmol^{-1}$
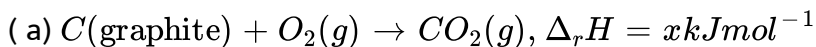
   A. z = x + y

   B. x = y - z

   C. x = y + z

   D. y = 2z - x

Answer: C

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70. The standard free energy changes (ΔG°) is related to equilibrium constant K_p as

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

B. $K_p \dfrac{-\Delta G^\circ}{RT}$
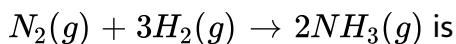
C. $K_p = RT \ln \Delta G^\circ$

D. $\Delta G = e^{K_P / RT}$

Answer: A

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71. If $\Delta_f G^\circ$ for $NH_3(g)$ is $-16.4 kJmol^{-1}$, then ΔG° for the reaction :

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

A. $32.8 kJmol^{-1}$

B. $16.4 kJmol^{-1}$

C. $-16.4 kJmol^{-1}$

D. $-32.8 kJmol^{-1}$

Answer: D

72. A cylinder of gas supplied by Bharat Petroleum is assumed to contain 14 kg of butane. If a normal family requires 20,000 kJ of energy per day for cooking, butane gas in the cylinder last .... days (ΔH_C of $C_4H_{10} = -2658kJ$ per mole)

A. 15 days

B. 20 days

C. 50 days

D. 32 days

Answer: D

73. Given :

$$C_2H_6(g) \rightarrow 2C(g) + 6H(g) : \Delta H = 712kcal$$
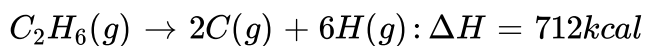
The C - C bond energy is 112 kcal, what is the C - H bond energy ?

A. 88 kcal

B. 12 kcal

C. 50 kcal

D. 100 kcal

Answer: D

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74. Four grams of graphite is burnt in a bomb calorimeter of heat capacity $30kJK^{-1}$ in excess of oxygen at 1 atmospheric pressure. The temperature rises from 300 to 304 K. What is the enthalpy of combustion of graphite (in $kJmol^1$) ?

A. 360

B. 1440

C. -360

D. − 1440

Answer: C

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75. A chemical reaction is spontaneous at 298 K but non-spontaneous at 350 K. Which one of the following is true for the reaction ?

A.

ΔG	ΔH	ΔS
−	−	+

B.

ΔG	ΔH	ΔS
+	+	+

C.

ΔG	ΔH	ΔS
−	+	−

D.

ΔG	ΔH	ΔS
−	−	−

Answer: D

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76. The bond energies of of C - C, C = C, H - H and C - H linkages are 350, 600, 400 and 410 kJ per mol respectively. The heat of hydrogenation of ethylene is

A. $-170kJmol^{-1}$

B. $-260kJmol^{-1}$

C. $-400kJmol^{-1}$

D. $-450kJmol^{-1}$

Answer: A

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

A. 11.4 kJ

B. $-11.4kJ$

C. 0 kJ

D. 4.8 kJ

Answer: C

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78. To neutrealize completely 20 mL of 0.1 M aqueous solution of phosphorus (H_3PO_3), the volume of 0.1 M aqueous KOH required is
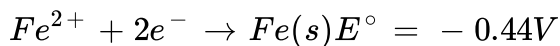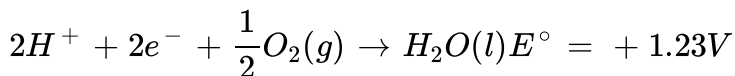
A. 10 mL

B. 20 mL

C. 40 mL

D. 60 mL

Answer: C

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79. The rusting of iron takes place as follows :

$$2H^+ + 2e^- + \frac{1}{2}O_2(g) \rightarrow H_2O(l)\,E^\circ = +1.23V$$

$$Fe^{2+} + 2e^- \rightarrow Fe(s)\,E^\circ = -0.44V$$

Calculate ΔG° for the net process

A. $-322kJmol^{-1}$

B. $-161kJmol^{-1}$

C. $-152kJmol^{-1}$

D. $-76kJmol^{-1}$

Answer: A

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80. For a spontaneous reaction, ΔG, equilibrium constant (K) and E_{cell}° will be respectively.
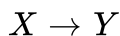
A. $-ve, > 1, +ve$

B. $+ve,\ >1,\ -ve$

C. $-ve,\ <1,\ -ve$

D. $-ve,\ >1,\ -ve$

Answer: A

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81. Consider an endothermic reaction :

$X \rightarrow Y$

with activation energies E_b and E_f for the backward and forward reactions respectively . In general

A. $E_b < E_f$

B. $E_b > E_f$

C. $E_b = E_f$

D. there is no definite relation between E_b and E_f

Answer: A

82. Consider the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$ carried out ata constant temperature and pressure. If ΔH and ΔU are the enthalpy and internal energy changes for the reaction, which of the following expressions is true ?

A. $\Delta H = 0$

B. $\Delta H = \Delta U$

C. $\Delta H < \Delta U$

D. $\Delta H > \Delta U$

Answer: C

83. If the bond dissociation energy of XY, x_2 $AND y_2$ (all diatomic molecules) are in the ratio of $1:1:0.5$ and $\Delta_f H$ for the formation of XY is $-200 kJmol^{-1}$. The bond dissociation energy of X_2 will be :

A. $100 kJmol^{-1}$

B. $200 kJmol^{-1}$

C. $800 kJmol^{-1}$

D. $400 kJmol^{-1}$

Answer: C

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84. $(\Delta U - \Delta H)$ for the formation of carbon monoxide (CO) from its elements of 298 K is $(R = 8.314 JK^{-1}mol^{-1})$

A. $1238.78 Jmol^{-1}$

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

C. $2477.57 Jmol^{-1}$

D. $-1238.78 Jmol^{-1}$

Answer: A

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85. For the process :

$H_2O(l)(1, 373K) \rightarrow H_2O(g)(1, 373K),$ the correct set of

thermodynamic parameter is :

A. $\Delta G = 0, \Delta S = +ve$

B. $\Delta G = 0, \Delta S = -ve$

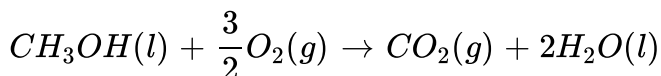C. $\Delta G = +ve, \Delta S = 0$

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

Answer: A

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1. In a fuel cell methanol is used as fuel and oxygen is used as an oxidiser.

The reaction is :

$$CH_3OH(l) + \frac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

At 298 K, standard Gibb's energies of formation for $CH_3OH(l)$, $H_2O(l)$ and $CO_2(g)$ are -166.2, -237.2 and -394.4 kJ/mol respectively. If standard enthalpy of combustion of methanol is - 726 kJ/mol, effeciency of the fuel cell will be :
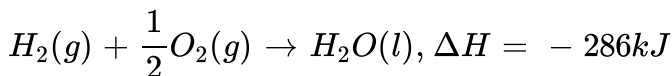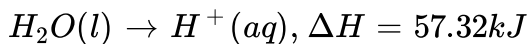
A. 80 %

B. 87 %

C. 90 %

D. 97 %

Answer: D

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2. On the basis of the following thermochemical data

$$\left[(\Delta_f G^\circ H^+(aq) = 0\right]$$

$$H_2O(l) \rightarrow H^+(aq), \Delta H = 57.32kJ$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H = -286kJ$$

The value of enthalpy of formation of OH^- at $25^\circ C$ is

A. $-22.88kJ$

B. $-228.88kJ$

C. $228.88kJ$

D. $-343.52kJ$

Answer: B

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3. 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 is NH_3 is

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

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

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

D. $+352 kJmol^{-1}$

Answer: D

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

A. T_e is five times T

B. $T = T_e$

C. $T_e > T$

D. $T > T_e$

Answer: D

---

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

A. $32.3 Jmol^{-1}K^{-1}$
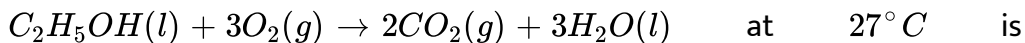
B. $42.3 Jmol^{-1}K^{-1}$

C. $38.3 Jmol^{-1}K^{-1}$

D. $35.8 Jmol^{-1}K^{-1}$

Answer: C

6. The value of enthalpy change (ΔH) for the reaction :

$$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l) \quad \text{at} \quad 27°C \quad \text{is}$$

$-1366.5 kJmol^{-1}$. The value of internal energy change for the above reaction at the temperature will be :
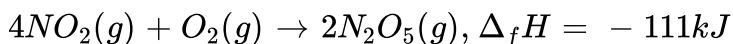
A. $-1369.0 kJ$

B. $-1364.0 kJ$

C. $-1361.5 kJ$

D. $-1371.5 kJ$

Answer: B

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7. Consider the reaction :

$$4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g), \Delta_f H = -111kJ$$

If $N_2O_5(s)$ is fromed instead of $N_2O_5(g)$ in the above reaction, the $\Delta_f H$

is value will be (given, ΔH of sublimation for N_2O_5 is $54 kJmol^{-1}$).

A. $+54kJ$

B. $+219kJ$

C. $-219kJ$

D. $-165kJ$

Answer: C

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8. The incorrect expression among the following is :

A. $K = e^{-\Delta G° / RT}$

B. $\dfrac{\Delta G_{\text{system}}}{\Delta S_{\text{total}}} = -T$

C. In isothermal process,

$$w_{\text{reversible}} = -nRT \ \ln\dfrac{V_f}{V_i}$$

D. $\ln K = \dfrac{\Delta H° - T\Delta S°}{RT}$

Answer: D

9. A piston filled with 0.4 mol of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of $37.0°C$. As it does so, absorb 208 J of heat. The values of q and w for the process will be :

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

A. $q = +208J, w = -208J$

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

C. $q = -208J, w = +208J$

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

Answer: A

10. For complete combustion of ethanol,

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$ the   amount   of   heat

produced as measured in bomb calorimeter is $1364.47 kJmol^{-1}$ at $25°C$.

Assuming ideality the enthalpy of comustion, $\Delta_c H$ for the reaction will

be $(R = 8.314 kJmol^{-1})$

    A. $- 1366.95 kJmol^{-1}$

    B. $- 1361.95 kJmol^{-1}$

    C. $- 1460.50 kJmol^{-1}$

    D. $- 1350.50 kJmol^{-1}$

Answer: A

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1. Enthalpy of vaporization of benzene is $+35.3 kJmol^{-1}$ at its boiling

point, $80°C$. The entropy change in the transition of the vapour to liquid

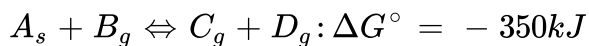at its boilling point [in $JK^{-1}mol^{-1}$] is ....

A. -441

B. -100

C. $+441$

D. $+100$

Answer: B

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2. For the reversible reaction :

$$A_s + B_g \Leftrightarrow C_g + D_g : \Delta G^\circ = -350kJ$$

Which one of the following statements is true ?

A. The entropy change is negative

B. Equilibrium constant is greater than one

C. The reaction should be instantaneous

D. The reaction is thermodynamically not feasible

Answer: B

3. The amount of heat evolved when $500cm^3$ of 0.1 M HCl is mixed with $200cm^3$ of 0.2 M NaOH is ....

A. 2.292 kJ

B. 1.292 kJ

C. 0.292 kJ

D. 3.392 kJ

Answer: A

4. During the adsorption of krypton on activated charcoal at low temperature ....

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: B

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

A. For an isochoric process : $\Delta U = -q$

B. For an adiabatic process : $\Delta U = -w$

C. For an isothermal process : $q = +w$

D. For an cyclic process : $q: -w$

Answer: D

6. A gas expands from a volume of $1m^3$ to a volume of $2m^3$ against an external pressure of $10^5\,Nm^{-2}$. The work done by the gas will be

A. $10^5\,kJ$

B. $10^2\,kJ$

C. $10^2\,J$

D. $10^3\,J$

Answer: B

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7. Which of the following statements is true ?

A. The total entropy of the universe remains constant

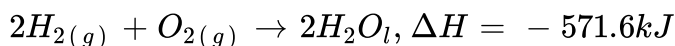B. The total entropy of the universe is continuously decreasing

C. The total energy of the universe is continuously decreasing

D. The total energy of the universe is remains constant

Answer: D

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8. For the thermochemical equation,

$$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_l, \Delta H = -571.6kJ$$

Heat of decomposition of water is :

A. $-571.6kJ$

B. $+571.6kJ$

C. $-1143.2kJ$

D. $+285.8kJ$

Answer: D

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9. The process is spontaneous at the given temperature, if

A. ΔH is +ve and ΔS is -ve

B. ΔH is -ve and ΔS is +ve

C. ΔH is +ve and ΔS is +ve

D. ΔH is +ve and ΔS is equal to zero

Answer: B

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10. The value of entropy of solar system is

A. increasing

B. decreasing

C. constant

D. zero

Answer: A

---

11. The ratio of heats liberated at 298 K from the combustion of one kg of coke and by burning water gas obtained from kg of coke is (Assume coke to be 100% carbon). (Given enthalpies of combustion of CO_2, CO and H_2 as 393.5 kJ, 285 kJ, 285 kJ respectively at 298 K).
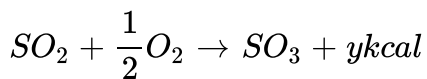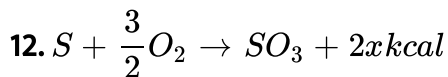
A. $0.79:1$

B. $0.69:1$

C. $0.86:1$

D. $0.96:1$

Answer: B

12. $S + \dfrac{3}{2}O_2 \rightarrow SO_3 + 2x\,kcal$

$SO_2 + \dfrac{1}{2}O_2 \rightarrow SO_3 + y\,kcal$

Find out the heat of formation of SO_2 :

   A. 2x - y

   B. x + y

   C. 2x + y

   D. x - y

Answer: A

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13. For one mole of NaCl(s) the lattice enthalpy is :

$Na(s) + \dfrac{1}{2}Cl_2(g) \xrightarrow{+108.4kJ\,/\,mol} Na(g) + \dfrac{1}{2}Cl_2(g) \xrightarrow{+495.6kJ\,/\,mol} Na^+(g) + $

$\xleftarrow[-411.2k\frac{J}{m}ol]{\hspace{2cm}} Na(s) + \dfrac{1}{2}Cl_2(g)$
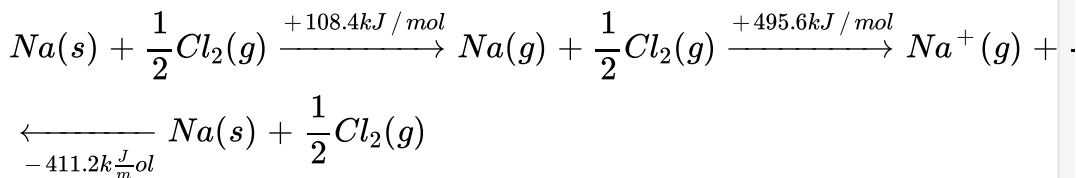
   A. $-788kJ\,/\,mol$

B. $+878kJ/mol$

C. $+788kJ/mol$

D. $-878kJ/mol$

Answer: A

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14. An endothermic reaction is found to have +ve entropy change. The reaction will be

A. Possible at high temperature

B. Possible only at low temperature

C. Not possible at any temperature

D. Possible at any temperature

Answer: A

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15. For an adiabatic change in a system, the condition which is applicable will be

    A. w = 0

    B. $q = -w$

    C. q = w

    D. q = 0

Answer: D

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