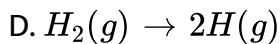# CHEMISTRY
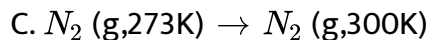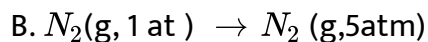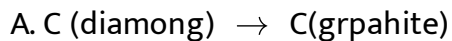
BOOKS - DISHA PUBLICATION CHEMISTRY (HINGLISH)

THERMODYNAMICS

Exercise

1. For which of the following processes is ΔS negative?

    A. C (diamong) $\rightarrow$ C(grpahite)

    B. N_2(g, 1 at) $\rightarrow N_2$ (g,5atm)

    C. N_2 (g,273K) $\rightarrow N_2$ (g,300K)

    D. $H_2(g) \rightarrow 2H(g)$

Answer: B

2. At 320 K, a gas A_2 is 20% dissociated to A(g). The standard free energy change at 320 K and 1 atm in $Jmol^{-1}$ is approximately :

$\left(R = 8.314 Jk^{-1}mol^{-1}, \text{In}2 = 0.693, \text{In}3 = 1.098\right)$

A. 1844

B. 2069

C. 4281

D. 4763

Answer: C

3. The combustion of benzene (l) gives $CO_2(g)$ and $H_2O(l)$. Given that heat of combustion of benzene at constant volume is $-3263.9 kJmol^{-1}$

at $25°C$, heat of combustion (in $kJmol^{-1}$) of benzene at constant pressure will be

(R = 8.314 JK–1 mol–1)

A. 4152.6

B. -452.46

C. 3260

D. -3267.6

Answer: D

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4. Which of the following lines correctly show the temperature dependence of equilibrium constant , for an exothermic reaction?
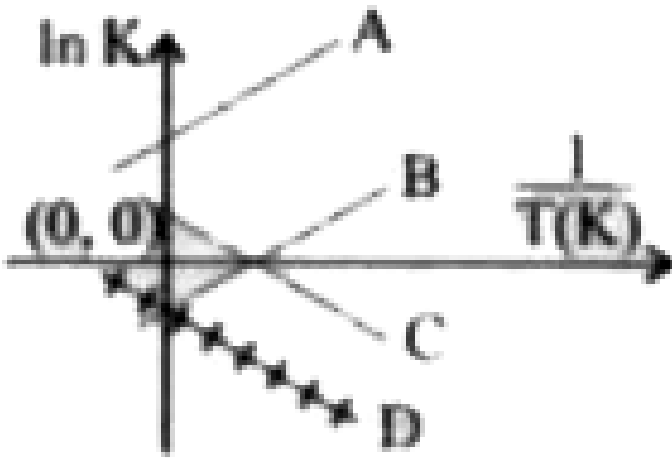
A. A and B

B. B and C

C. C and D

D. A and D

Answer: A

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5. For a reaction, $A(g) \rightarrow A(l), \Delta H = -3RT$

The correct statement for the reaction is :

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

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

C. $|\Delta H| < |\Delta U|$

D. $|\Delta H| > |\Delta U|$

Answer: D

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6. The enthalpy change of freezing of 1 mol of water at $5°C$ to ice at $-5°C$ is

(Given $\Delta_{fus} H = 6kJmol^{-1}$ at $0°C$,

$\left(C_p(H_2O, s) = 36.8Jmol^{-1}K^{-1}\right)$

A. $5.44kJmol^{-1}$

B. $5.81 kJ\mathrm{mol}^{-1}$

C. $6.56 kJ\mathrm{mol}^{-1}$

D. $6.00 kJ\mathrm{mol}^{-1}$

Answer: C

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7. δU is equal to

A. Isochoric work
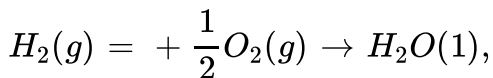
B. Isobaric work
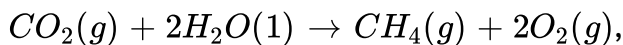
C. Adiabatic work

D. Isothermal work

Answer: C

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8. Given $C_{(\text{graphite})} + O_2(g) \rightarrow CO_2(g),$

$\Delta_r H^0 = -393.5 kJ \quad mol^{-1}$

$H_2(g) = +\dfrac{1}{2}O_2(g) \rightarrow H_2O(1),$

$\Delta_r H^0 = -285.8 \ kJ \ mol^{-1}$

$CO_2(g) + 2H_2O(1) \rightarrow CH_4(g) + 2O_2(g),$

$\Delta_r H^0 = +890.3 kJ \quad mol^{-1}$

Based on the above thermochemical equations, the value of $\Delta_r H^0$ at at

298 K for the reaction

$C_{(\text{graphite})} + 2H_2(g) \rightarrow CH_4(g)$ will be:
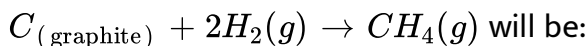
A. $+74.8 kJ\text{mol}^{-1}$

B. $+144.0 kJ\text{mol}^{-1}$

C. $-74.8 kJ\text{mol}^{-1}$

D. $-144.0 kJ\text{mol}^{-1}$

Answer: C

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9. A reaction at 1 bar is non-spontaneous at low temperature but becomes spontaneous at high temperature. Identify the correct statement about the reaction among the following:

A. ΔH is negative while ΔS is positive

B. Both ΔH and ΔS are negative

C. ΔH is positive whele ΔS is negative

D. Both ΔH and ΔS are positive

Answer: D

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10. If 100 mole of H_2O_2 decompose at 1 bar and 300 K, the work done (kJ) by one mole of $O_2(g)$ as it expands against 1 bar pressure is

$$2H_2O_2(l) \rightleftharpoons 2H_2O(l) + O_2(g)$$
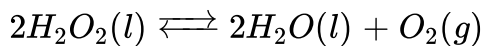
$$(R = 8.3 JK^{-1}mol^{-1})$$

A. 124.5

B. 249

C. 498

D. 62.25

Answer: A

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11. The heats of combustion of carbon and carbon monoxide are -393.5 and $-283.5 kJmol^{-1}$ respectively. The heat of formation (in kJ) of carbon monoxide per mole is:

A. -676.5

B. -110.5

C. 110.5

D. 676.5

Answer: B

12. the heat of atomization of methane and ethane are 360 KJ/mol and 620 KJ/mol , respectively . The longest Wavelength of light capable of breaking . The c-c bond is :

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

A. $2.48 \times 10^4 m$

B. $1.49 \times 10^3 m$

C. $2.48 \times 10^3 m$

D. $1.49 \times 10^4 nm$

Answer: B

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

A. -1102 kJ/mol

B. -964kJ/mol

C. $+352$ kJ/mol

D. $+1056$kJ/mol

Answer: B

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14. For the 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 combustion, ΔH_C , for the reaction will be

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

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

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

C. $-1460.95 kJmol^{-1}$

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

Answer: A

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15. Which has maximum internal energy at $290K$?

A. Neon gas

B. Nitrogen gas

C. Ozone gas

D. Equal for al

16. One mole of non $-$ ideal gas undergoes a change of state $(1.0atm, 3.0L, 200K)$ to $(4.0atm, 5.0L, 250K)$ with a change in internal energy $(\Delta U) = 40L - atm$. The change in enthalpy of the process in $L - atm$,

A. 43

B. 57

C. 42

D. None of these

17. The molar specific heat of an ideal gas at constant pressure and constant volume is C_p and C_v respectively. If R is the universal gas constant and the ratio of C_p to C_v is γ, then C_v.

A. $\dfrac{R}{\gamma - 1}, \dfrac{\gamma R}{\gamma - 1}$

B. $(\gamma R), (\gamma - 1), \dfrac{R}{\gamma - 1}$

C. $\dfrac{\gamma - 1}{\gamma R}, \dfrac{\gamma - 1}{R}$

D. $\dfrac{\gamma - 1}{R}, \dfrac{\gamma - 1}{\gamma R}$

Answer: B

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18. If H is considered as the function of P and T, then which of thefollowing relations is/are corret?

A. $dH = \left(\dfrac{dH}{dT}\right)_P dT = \left(\dfrac{dH}{dP}\right)_T dP$
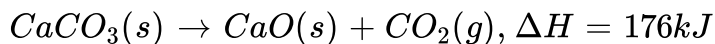
B. $dH = C_P dT + \left(\dfrac{dH}{dP}\right)_T dP$

C. $\left(\dfrac{dH}{dP}\right)_T = -V$

D. All of the above

Answer: D

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19. Given the reaction at $975°C$ and 1 atm.

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g), \Delta H = 176kJ$

Then ΔE is equal to

A. 186.4kJ

B. 162kJ

C. 165.63kJ

D. 180kJ

Answer: C

20. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 L to 10 L. The ΔE for this process is (R=2 cal . $\text{mol}^{-1}K^{-1}$)

   A. 163.7cal

   B. zero

   C. 1381.1cal

   D. 9lit. Atm

Answer: B

21. When 1 mol of gas is heated at constant volume temperature is raised from 298 to 308 K. Heat supplied to the gas is 500 J. Then which

statement is correct ?

A. $q = w = 500J, \Delta U = 0$

B. $q = \Delta = 500J, w = 0$

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

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

Answer: B

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

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

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

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

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

Answer: A

23. Which one for the following statement is false

    A. Work is a state function.

    B. Temperature is a state function.

    C. Change in the state is completely defined when the initial and

       final states are specified

    D. None of the above

Answer: A

24. In an adibatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic conditions 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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25. During isothermal expansion of an ideal gas, its:

A. inernal energy increases

B. enthalpy decreases

C. enthalpy remains unaffected

D. enthalpy reduces to zero.

Answer: C

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26. Which of the following are not state functions?

(I) $q + w$

(II) q

(III) w

(IV) $H - TS$

    A. (I) and (IV)

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

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

    D. (II) and (III)

Answer: D

27. For a cyclic process, which of the following is not true?

A. $\Delta H = 0$

B. $\Delta E = 0$

C. $\Delta G = 0$

D. Total $W = 0$

Answer: D

28. Work out the heat change (cal) when 40 g of He gas at $27°C$ undergoes isothermal and reversibel compression from initial pressure of 1 atm to 10 atm $\left(R = 2calK^{-1}mol^{-1} \right)$

A. 13.818k cal

B. -13.818 kcal

C. 55.272kcal

D. -55.272 k cal

Answer: B

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29. If an ideal gas does the work of expansion solely at the cost of its internal energy, the process is

A. reversible

B. irrerversible

C. isothermal

D. adiabatic

Answer: D

30. In order to maintain constant temperature of a system involving an

ideal gas, heat has to be removed. Then what is true?

A. The gas is being compressed

B. The gas is undergoing expansion

C. The gas is performing the work

D. There is neither expansion nor contraction of the gas

Answer: A

31. Temperature of 5 moles of a gas a decreased by 2K at constant

pressure. Indicate the correct statement.

A. work done by the gas $=5R$

B. work done by the gas =10R

C. work done over the gas =10R

D. work done =0

Answer: C

32. A gas absorbs 200J heat and undergoes simultaneous expansion against a constant external pressure of 10^5 Pa. The volume changes from 4L to 5L. The change in internal energy is

A. 300J

B. 100J

C. $-330J$

D. $-100J$

Answer: B

33. The maximum work done when pressure on 10 g of hydrogen is reduced from 20 to 1 atm at a constant temeprature of 273 will be

A. 8170 cal

B. 8180 cal

C. 8200 cal

D. 8350 cal

Answer: B

34. A sample of liquid in a thermally insulated constant (a calorimetre) is strirred for 2 hr. by a mechancal linkage to motor in the surrounding ,for this procees :

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

B. $w > 0g > 0, \Delta U > 0$

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

D. $w > 0q = 0, \Delta U > 0$

Answer: D

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35. For a reversible adiabatic ideal gas expansion $\dfrac{dp}{p}$ is equal to

A. $\gamma \dfrac{dV}{V}$

B. $-\gamma \dfrac{dV}{V}$

C. $\left(\dfrac{\gamma}{\gamma - 1}\right) \dfrac{dV}{V}$

D. $\dfrac{dV}{V}$

Answer: B

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

A. ΔH is always greaer than ΔE

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

C. ΔH is a always less than ΔE

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

Answer: D

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

A. 6.6K

B. 1.2K

C. 2.4K

D. 4.8K

Answer: C

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

A. use of different reactants for the same product

B. the nature of intermediate reaction steps

C. the differences in initial or final temperatures of involved substances.

D. the physical states of reactants and products.

Answer: B

39. Consider the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$ carried out at 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. $\Delta h > \Delta U$

B. $\Delta H < \Delta U$

C. $\Delta H = \Delta U$

D. $\Delta H = 0$

Answer: B

---

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

A. O_3, CO_2, NH_3, HI

B. CO_2, NH_3, HI, O_3

C. O_3, HI, NH_3, CO_2

D. NH_3, HI, CO_2, O_3

Answer: C

41. The heat of combustion of carbon to CO_2 is $-395.5kJ/mol$. The heat released upon the formation of $35.2g$ of CO_2 from carbon and oxygen gas is
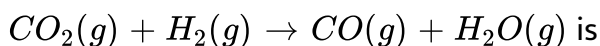
A. $+315kJ$

B. $-31.5kJ$

C. $-315kJ$

D. $+31.5kJ$

Answer: C

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42. The ΔH_f° for $CO_2(g)$, CO(g) and $H_2O(g)$ are -395.5, -110.5 and -241.8 kJmol^{-1} respectively. The standard enthalpy change in (in kJ) for the reaction

$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$ is
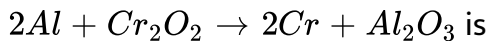
A. 524.1

B. 41.2

C. -262.2

D. -41.2

Answer: B

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43. The enthalpies of formation of Al_2O_3 and Cr_2O_3 are $-1596KJ$ and $-1134KJ$ respectively. ΔH for the reaction

$2Al + Cr_2O_2 \rightarrow 2Cr + Al_2O_3$ is

A. $-2730kJ$

B. $-462lK$

C. $-1365kJ$

D. $+2730kJ$

Answer: B

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

A. $x = y$

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

C. $x = 2y$

D. None of these

Answer: B

45. The reaction $A \rightarrow B$, $\Delta H = +24kJ/\text{mole}$. For the reaction $B \rightarrow C, \Delta H = -18kJ/\text{mole}$. The decreasing order of enthalpy of A, B, C follow the order

A. A,B,C

B. B,C,A

C. C,B,A

D. C,A,B

Answer: B

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

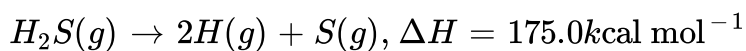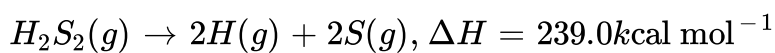The bond energy of $H - H$ bond will be

A. 104 kcal

B. 52kcal

C. 10.4kcal

D. 1040 kcal

Answer: A

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47. Calculate enthalpy change for the change $8S(g) \rightarrow S_8(g)$, given that

$H_2S_2(g) \rightarrow 2H(g) + 2S(g), \Delta H = 239.0 kcal\ mol^{-1}$

$H_2S(g) \rightarrow 2H(g) + S(g), \Delta H = 175.0 kcal\ mol^{-1}$

A. $+512.0$ k cal

B. -512.0 k cal

C. 508.0 kcal

D. -508.0 kcal

Answer: B

---

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

A. $\left(T_f\right)_{rev} = \left(T_f\right)_{irrev}$
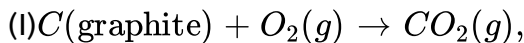
B. $T_f = T_i$ for both reversible and irreversible provesses

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

D. $T_f > T_i$ for reversible process but $T_f = T_i$ for irreversible process

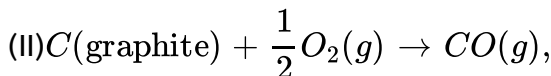**Answer: C**

49. On the basic of thermochemical equations (I),(II)and (III), Find out which of the algebraic relationships given in options (a)to (d) is correct ?

(I)$C(\text{graphite}) + O_2(g) \rightarrow CO_2(g),$

$\Delta_r H = X KJmol^{-1}$

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

$\Delta_r H = y KJmol^{-1}$

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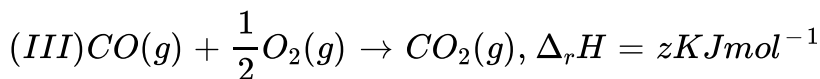
A. $z = x + y$

B. $x = y - z$

C. $x = y + z$

D. $y = 2z - x$

Answer: C

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50. Following reaction occurring in an automobile

$2C_8H_{18}(g) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$. The sign of

$\triangle H$, $\triangle S$ and $\triangle G$ would be-

A. $+$, $-$, $+$

B. $-$, $+$, $-$

C. $-$, $+$, $+$

D. $+$, $+$, $-$

Answer: B

51. Enthalpy of $CH_4 + \dfrac{1}{2}O_2 \rightarrow CH_3OH$ is

negative. If enthalpy of combustion of CH_4 and CH_3OH are x and y

respectively, then which relation is correct?

A. $x > y$
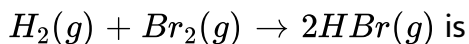
B. $x < y$

C. $x = y$

D. $x \geq y$

Answer: B

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52. If the end 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. $-261kJ$

B. $+103kJ$

C. $+261kJ$

D. $-103kJ$

Answer: D

53. Calculate the standard enthalpy change (in kJ mol^{-1}) for the reaction $H_2(g) + O_2(g) \rightarrow H_2O_2(g)$, given that bond enthalpy of H-H, O=O,O-H and O-O (in kJ mol^{-1}) are respectively 438, 498, 464 and 138.

A. 130

B. -65

C. $+130$

D. -334

Answer: A

54. Four grams of graphite is burnt in a bomb calorimeter of heat capacity $30 kJK^{-1}$ is excess of oxygen at 1 atmospheric pressure. The

temperature rises from 300 to 304 K. What is the enthalpy of combustion of graphite (in kJ mol^{-1})?

A. 360

B. 1440

C. -360

D. -1440

Answer: C

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

A. The dissociation energy of the hydrogen molecule H_2

B. The first four ionisation energies of carbon

C. The dissociation energy of H_2 and enthalpy and sublimation of carbon (graphite)

D. The first four ionisation energies of carbon and electron affinity of hydrogen.

Answer: A

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56. At $25°C$ and 1 bar which one of the following has a non zero $\Delta H_f^°$?

A. $Br_2(1)$

B. C (graphite)

C. I_2

D. $O_3(g)$

Answer: D

▶

57. The enthalpy of neutralization of NH_4OH and CH_3COOH is – 10.5 kcal/mole and enthalpy of neutralization of strong base and CH_3COOH is – 12.5 kcal/mole. Calculate the enthalpy of dissociation of NH_4OH-

A. $4.0kcal \, mol^{-1}$

B. $3.0kcal \, mol^{-1}$

C. $2.0kcal \, mol^{-1}$

D. $3.2kcal \, mol^{-1}$

Answer: C

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58. 250 mLof 0.1 M HCL and 250 mL of 0.1 M KOH, both being at the same temperature, are mixed throughtly and the temperature rise is found to

be ΔT_1. If the experiment is repeated using 500 mL each of the two solutions and ΔT_2 is the temperature rise, then which is true?

A. $\Delta T_2 > 2\Delta T_1$

B. $\Delta T_1 = 2\Delta T_2$

C. $\Delta T_1 = \Delta T_2$

D. None of these

Answer: C

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59. When 0.2 mole of anhydrous $CuSO_4$ is dissolved in water, the heat evolved is 1.451 kcal. If 0.2moleof $CuSO_4.5H_2O$ is dissolved in water, the heat absorbed is 0.264 kcal. Calculate the molar heat of hydration of $CuSO_4$

A. 11.87 kcal

B. $- 11.87$ kcal

C. 17.15 kcal

D. $- 17.15$ kcal

Answer: D

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60. The standard heat of formation values of $SF_6(g)$, $S(g)$, and $F(g)$ are -1100, 275, and $80 kJ mol^{-1}$, respectively. Then the average $S - F$ bond enegry in SF_6
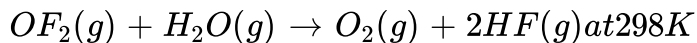
A. 309kJ

B. 315kJ

C. 320kJ

D. 300kJ

Answer: A

61. Calculate the standard enegry change for the reaction:

$$OF_2(g) + H_2O(g) \rightarrow O_2(g) + 2HF(g) \, at \, 298K$$

The standard enthalpies of formation of $OF_2(g)$, $H_2O(g)$, and $HF(g)$ are $+20$, -250, and $-270 kJmol^{-1}$, respectively.

A. $-307.52kJ$

B. $315.25kJ$

C. $-320.12kJ$

D. $320.12kJ$

Answer: A

62. The fat $C_{57}H_{104}O_6(s)$, is metabolised via the following reaction

$C_{57}H_{104}O_6(s) + 80O_2(g) \rightarrow 57CO_2(g) + 52H_2O(1)$ the energy (kJ)

liberated when 1.0 g of this fat reacts will be Given the enthapies of

formation

$\Delta_f H^\circ (C_{57}H_{104}O_6 s) = -70870$kJ/mol

$\Delta_f H^\circ (H_2O, l) = -285.8$ kJ/mol

$\Delta_f H^\circ (CO_2, g) = -393.5$ kJ/mol

A. -37.98

B. -40.4

C. -33.4

D. -30.2

Answer: A

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63. Stearic acid $\left[CH_3(CH_2)_{16}CO_2H\right]$ is a fatty acid the part of fat that stores most of the energy .1.0 g of Stearic acid was burnt in a bomb calorimeter . The bomb had capacity of 652 $J/^\circ C$. If the temperature of 500 g water rose from 25.0 to $39.3^\circ C$ how much heat is released when the stearic acid was burned?

$\left[\text{Given } C_p(H_2O) = 4.18J/g^\circ c\right]$

A. 39.21kJ

B. 29.91kJ

C. 108kJ

D. 9.32kJ

Answer: A

64. An imaginary reaction $X \rightarrow Y$ takes place in three steps

$$X \rightarrow A, \Delta H = -q_1, \quad B \rightarrow A, \Delta H = -q_2, \quad B \rightarrow Y, \Delta H = -q_3$$

If Hess's law is applicable, then the heat of the reaction $(X \rightarrow Y)$ is :

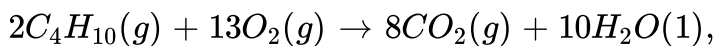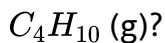A. $q_1 - q_2 + q_3$

B. $q_2 - q_3 - q_1$

C. $q_1 - q_2 - q_3$

D. $q_3 - q_2 - q_1$

Answer: B

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65. What amount of energy (kJ) is released in the combustion of 5.8 of C_4H_{10} (g)?

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(1),$$

$$\Delta H^\circ = -5756kJ$$

A. 575.6

B. 287.8

C. 182

D. 57.56

Answer: B

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66. If $S + O_2 \rightarrow SO_2, \Delta H = -298.2 \ \text{kJ} \ \text{mole}^{-1}$

$SO_2 + \dfrac{1}{2}O_2 \rightarrow SO_3 \Delta H = -98.7 \ \text{kJ} \ \text{mole}^{-1}$

$SO_3 + H_2O \rightarrow H_2SO_4, \Delta H = -130.2 \ \text{kJ} \ \text{mole}^{-1}$

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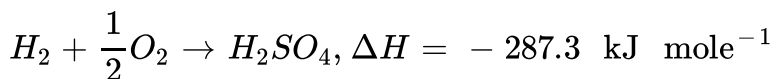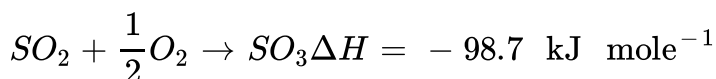
the enthlapy of formation of H_2SO_4 at 298 K will be

A. $-814.4kJ$

B. $-650.3kJ$

C. $-320.5kJ$

D. $-233.5kJ$

Answer: A

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67. If bond energies are denoted by ε, the enthalpy of the reaction:

$CH \equiv CH(g) + 2H_2(g) \rightarrow C_2H_6(g)$ is
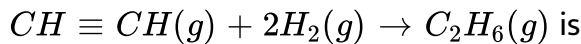
A. $E_{C \equiv C} + 2E_{H-H} - E_{C-C} - 4E_C - H$

B. $E_{C \equiv C} + 2E_{H-H} - E_{C-C} - 6E_{C-H}$

C. $E_{C \equiv C} - 2E_{H-H} - E_{C-C} - 4E_C - H)$

D. $E_{C \equiv C} + 2E_{H-H} - E_{C=C} - 4E_{C-H}$

Answer: A

68. Identify the correct statement regarding entropy

    A. At absolute zero temperature, the entropy of perfectly crystaline substances is positive.

    B. At abosolute zero temperature, entropy of perfectly crystalline substance is take to be zero.

    C. At $0°C$ the entropy of a perfectly crystalline substance is take to be zero.

    D. At absolute zero temperature the entropy of all cyrstalline substances is taken to be zero.

Answer: B

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69. The enthalpy change for a given reaction at $298K$ is $-x\,cal\,mol^{-1}$. If the reaction occurs spontaneously at $298K$, the entropy change at that temperature

A. can be negative, but numerically greater than $\dfrac{x}{298}JK^{-1}$

B. can be negative,but numerically smaller tha $\dfrac{x}{298}JK^{-1}$.

C. can not be negative
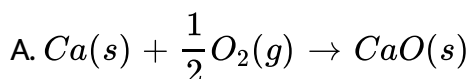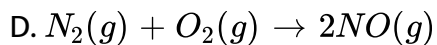
D. can not be positive

Answer: B

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70. ΔS° wil be highest for the reaction

A. $Ca(s) + \dfrac{1}{2}O_2(g) \rightarrow CaO(s)$

B. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

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

D. $N_2(g) + O_2(g) \rightarrow 2NO(g)$
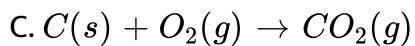
Answer: B

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71. In which of the following entropy decreases?

A. Crystallization of sucrose from solution

B. Rusting of iron

C. Metling of ice

D. Vaporization of camphor

Answer: A

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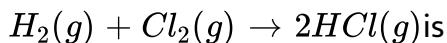**72.** Given the following entropy values (in $JK^{-1}mol^{-1}$) at 298 K atm :

$H_2(g) : 130.6. \ Cl_2(g) : 223.0$ and $HCl(g) : 186.7$. The entropy change

(in $JK^{-1}mol^{-1}$) for the reaction

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ is

A. $+540.3$

B. $+727.0$

C. -166.9

D. $+19.8$

Answer: D

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73. Which one fo the following demonstrates a decreases 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

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74. When 1.8 g of steam at the normal boiling point of water is converted into water at the same temperature, enthalpy and entropy changes respectively will be (ΔH_{vap} (for water) $= 40.8 kJ\text{mol}^{-1}$)

A. $4.08 kJ, 10.93 JK^{-1}$

B. $-4.08 kJ, -40.8 JK^{-1}$

C. $-4.04 kJ, -10.93 JK^{-1}$

D. $4.08 kJ, 40.8 JK^{-1}$

Answer: C

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75. An athelete in a gymansium room lifts a $50kg$ mass through a vertical distance of $2.0m$, $g = 9.8ms^{-2}$. The mass is allowed to fall through 2.0 m distance while coupled to an electrical generator. The electrical generator produces an equal amount of electrical work. this electrical work is used to produce aluminium by hall's process involving the change, $Al_2O_3(\text{molten}) + 3C_{(s)} \rightarrow 2Al_{(l)} + 3CO_{(g)}$

The reaction require standard free energy change equal to $593kJ$. how many times must the athelete lift $50kg$ mass and to drop and couple with generator to produce sufficient Gibbs free energy to produce $27gAl$?

    A. 325

    B. 315

    C. 303

    D. 325

Answer: C

76. If for the raction at 300 K,

$$2Mg(g) + O_2(g) \rightarrow 2MgO(s), \Delta_r H = -1202 kJmol^{-1}$$ and

$\Delta_r S = -217.0 JK^{-1}mol^{-1}$ The total entropy change $(\Delta S)_T$ and gibbs energy change during the course of reaction $(\Delta_r G)$ are respectively.

A. $3.79 \times 10^3 Jk^{-1}mol^{-1}, -1136.9kJ$

B. $3.79 \times 10^3 Jk^{-1}mol^{-1} + 1000J$

C. $+1000 JK^{-1}mol^{-1}, 3.79 \times 10^3 J$

D. $-1136.9kJ, 3.79 \times 10^3 J$

Answer: A

77. Which of the following pairs of a chemical reaction is certaion to result a spontaneous reaction ?

A. Exothermic and increasing disorder

B. Exothermic and decreasing disorder

C. Endorthermic and increasing disorder

D. Endothermic and decreasing disorder

Answer: A

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78. The enthalpy and entropy change for the reaction

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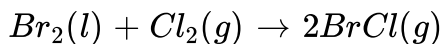
are $30 kJmol^{-1}$ and $105 JK^{-1}mol^{-1}$ respectively. The temeprature at which the reaction will be in equilibrium is

A. 273K

B. 450K

C. 300K

D. 285.7K

Answer: D

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79. ΔG in $Ag_2O \rightarrow 2Ag + 1/2O_2$ at a certain temperature is $-10kJmol^{-1}$. Pick the correct statement.

A. Ag_2O decomposes to Ag and O_2

B. Ag and O_2 combines to form Ag_2O

C. Reaction is in equilibrium

D. Reaction does not take place

Answer: A

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80. Identify the correct statement for change of Gibbs energy for a system $\left(\Delta G_{\text{system}}\right)$ at constant temperature and pressure.

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

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

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

    D. If $\Delta G_{\text{system}} > 0$, the process is not spontaneous.

Answer: A

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81. A spontaneous reaction is impossible if

    A. both ΔH and $De < sS$ are negative.

B. both ΔH and ΔS are positive

C. ΔH is negative and ΔS is positive.

D. ΔH is positive and ΔS is negative.

Answer: D

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82. Pick out the wrong statement

A. The 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 fo a perfectly crystalline substance at absolute zer is zero

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

Answer: D

83. The dissolution of NH_4CI in water is endothermic even though NH_4CI dissolves in water spontaneously. Which one of the following best explains this behaviour?

    A. Endothermic processes are energetically favoured.

    B. The electrostatic bonds between the ions are not too strong.

    C. Energy changes have nothing to do with the dissolution processes.

    D. The entropy driving force causes the dissoltion.

Answer: D

84. Which of the following thermodynamic condition at constant pressure and temperature is necessary for the spontaneity of a process?

A. $d(U - TS + PV) > 0$

B. $d(U - TS + PV) < 0$

C. $d(U - TS + PV) = 0$

D. $d(U + TS + PV) < 0$

Answer: B

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85. A rigid and insulated tank of $3m^3$ volume is divided into two compartments. One compartment of volume of $2m^3$ contains an ideal gas at 0.8314 Mpa and 400 K while the second compartment of volume of $1m^3$ contains the same gas at 8.314 Mpa and 500 K. If the partition

between the two compartments is rptured, the final temperature of the gas is :

A. 420K

B. 450K

C. 480K

D. None of these

Answer: C

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86. 18g of ice is converted into water at $0°C$ and 1 atm. The entropies of H_2O (s) and H_2O (l) are 38.2 and 60J/mol K respectively. The enthalpy cange for this conversion is:

A. 5951.4 J/mol

B. 595.14 Jmol

C. -5951.4 J/mol

D. None of these

Answer: A

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

(Given : $\Delta H_{combustion}(\text{sucrose}) = -6000 kJmol^{-1}$

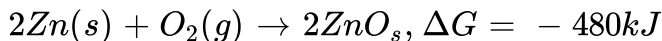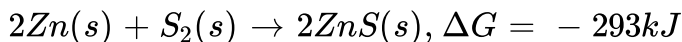$\Delta S_{combustion} = 180j/K - mol$ and bodyntemperature is 300 K)

A. 600kJ

B. 594.6kJ

C. 5.4kJ

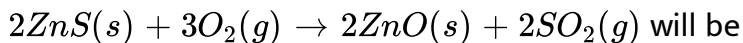**88.** The factor of ΔG values is important in meltallurgy. The ΔG values for the following reactions at $800^\circ C$ are given as

$S_2(s) + 2SO_2(g) \rightarrow 2SO_2(g), \Delta G = -544kJ$

$2Zn(s) + S_2(s) \rightarrow 2ZnS(s), \Delta G = -293kJ$

$2Zn(s) + O_2(g) \rightarrow 2ZnO_s, \Delta G = -480kJ$

Then ΔG for the reaction

$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$ will be

A. $-357kJ$

B. $-731kJ$

C. $773kJ$

D. $-229kJ$

Answer: B

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

A. $9.92 \times 10^5 Pa$

B. $11.094 \times 10^8 Pa$

C. $10.952 \times 10^7 Pa$

D. $9.92 \times 10^6 Pa$

Answer: B

90. For the reaction taking place at certain temperature $NH_2COONH_4(s) \Leftrightarrow 2NH_3(g) + CO_2(g)$ if equilibrium pressure is 3 X bar then $\Delta_r G^\circ$ would be

A. $-RT$ In 9-3RTIn X

B. RT In 4-3RTIn X

C. $-3RT$ In X

D. None of these

Answer: D

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91. According to the first law of thermodynamics which of the following quantities represents change in a state function ?

A. q_{rev}

B. $q_{rev} - w_{rev}$

C. $q_{\text{rev}} / w_{\text{rev}}$

D. $q_{\text{rev}} + w_{\text{rev}}$

Answer: D

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92. When 110 g of manganese (At mass =55) dissolves in dilute HNO_3 at $27° C$ under atmosphere pressure, the work done in the process is

    A. $2494.2 J$

    B. $- 2494.2 J$

    C. $- 4988.4 J$

    D. $4988.4 J$

Answer: C

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93. Work done for converson of 0.5 mole of water of $100°C$ to steam at 1 atm pressure is (heat of vaporisation of water at $100°C$ is $4070 J \text{mol}^{-1}$)

    A. $-1.54kJ$
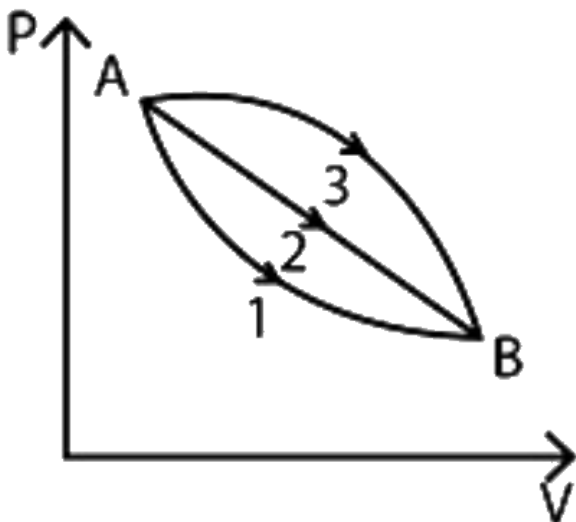
    B. $1.54kJ$

    C. $1.25kJ$

    D. $-1.35kJ$

Answer: A

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94. 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 are be the works 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. $w_2 < w_3 < w_1$

Answer: B

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95. If the door of a refrigerator is kept open, then which of the following is true

    A. gets cooled

    B. gets heated

    C. neither gets cooled nor gets heated

    D. gets cooled or heated depending on the initial temperature of the room

Answer: B

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96. 10 mole of ideal gas expand isothermally and reversibly from a pressure of $10atm$ to $1atm$ at $300K$. What is the largest mass which can lifted through a height of 100 meter?

    A. 31842 kg

B. 58.55 kg

C. 342.58kg

D. 6051 kg

Answer: B

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97. One mole of an ideal gas $\left(C_{v,m} = \dfrac{5}{2} R \right)$ at 300 K and 5 atm is expanded adiabatically to a final pressure of 2 atm against a constant pressure of 2 atm. Final temperature of the gas is :

A. 270K

B. 273K

C. 248.5K

D. 200K

Answer: C

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

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

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

C. $2x - y$

D. $y - 2x$

Answer: B

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

heat of combustion of CH_4 in $kJ\text{mol}^{-1}$ is

A. 890

B. -160

C. -890

D. -90

Answer: C

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100. The heat of neutralisation of strong base and strong acid is 57.0kJ/mol. The heat released when 0.5 mole of HNO_3 is added to 0.20 mole of NaOH solution is

A. 34.9kJ

B. 57.0kJ

C. 11.4kJ

D. 28.5kJ

Answer: C

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101. If enthalpies of methane and enthane are respectively 320 and 560 calories, then the bond energy of C-C bond is :

A. 50 calories

B. 80 calories

C. 40 calories

D. 120 calories

Answer: B

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102. The heats of atomization of $PH_3(g)$ and $P_2H_4(g)$ are 954 kJ mol^{-1} and $1485 kJmol^{-1}$ respectivel. The P-P bond energy in $kJmol^{-1}$ is

A. 213

B. 426

C. 318

D. 1272

Answer: A

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103. Calculate the resonance enegry of N_2O form the following data

$\Delta_f H^\ominus of N_2O = 82 kJmol^{-1}$

Bond enegry of $N \equiv N, N = N, O = O,$ and $N = O$ bond is 946, 418, 498, and $607 kJmol^{-1}$, respectively.

A. $- 88 kJ$

B. $-66kJ$

C. $-62kJ$

D. $-44kJ$

Answer: A

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104. Enthalpy change for the reaction

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ is $-57.3kJmol^{-1}$ If 1 L of 0.5

$MHNO_3$ is mixed with 2 L of 0.2 M KOH, the enthalpy change would be

A. $-28.65kJ$

B. $28.65kJ$

C. $-22.92kJ$

D. $11.46kJ$

Answer: C

105. If enthalpy of combustion of carbon, hydrogen and C_3H_8 are x_1, x_2 and x_3 per mol^{-1} respectively , then the enthalpy of formation of C_3H_8 will be

A. $x_3 - x_1 - x_2$

B. $x_3 - 3x_1 - 4x_2$

C. $3x_1 + 4x_2 - x_3$

D. $x_1 + x_2 - x_3$

Answer: C

106. The heat of sublimation of iodine is $24 cal g^{-1}$ at $50°C$. If specific heat of solid iodine and its vapour are 0.055 and $0.031 cal g^{-1}$

respectively, the heat of sublimation of iodine at $100°C$ is

A. $22.8\text{cal}g^{-1}$

B. $25.2\text{cal}g^{-1}$

C. $-22.8\text{cal}g^{-1}$

D. $-25.2\text{cal}, g^{-1}$

Answer: A

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107. The specific heat of a monoatomic gas at constant pressure is 248.2 $J\ kg^{-1}K^{-1}$ and at constant volume it is 149.0 J $kg^{-1}K^{-1}$. Find the mean molar mass of the gas.

A. $83.8 g\text{mol}^{-1}$

B. $84.0 g\text{mol}^{-1}$

C. $82 g\text{mol}^{-1}$

D. $80gmol^{-1}$

Answer: A

108. A steam boiler made up of steel weights 900 kg. The boiler contains 400 kg of water. Assuming 70% of the heat is delivered to boiler and water. Heat required to raise the temperature of the whole from $10°C$ to $100°C$ is (Heat capacity of steel is 0.11 kcal/kg-K and heat capacity of water is 1 kcal /kg-K)

    A. 63550kcal

    B. 64200k cal

    C. 64157 k cal

    D. 65250 k cal

Answer: C

109. The enthalpy of neutraliztion of weak base A OH and a strong base BOH by HCl are -12250 cal/mol and -13000 cal/mol respectively . When one mole of HCl is added to a solution containting 1 mole of A OH and 1 mole of BOH , the enthalpy change was -12500 cal/mol . In what ratio is the acid distribution between A OH and BOH?

A. $2:1$

B. $2:3$

C. $1:2$

D. $3:2$

Answer: A

110. Two moles of ideal gas at $27°C$ temperature is expanded reversibly from 2 litre to 20 liter. Find entropy change $(R = 2cal/molK)$.

A. 92.1

B. 0

C. 4

D. 9.2

Answer: D

111. Molar heat capacity of CD_2O (deuterated form of formaldehyde) at constant pressure in $9calmol^{-1}K^{-1}at1000K$. Calculate the entropy change associated with cooling of $3.2g$ of CD_2O vapour from $1000 \rightarrow 900K$.

A. $-0.1calK^{-1}$
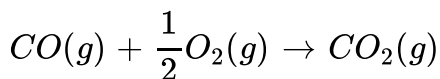
B. $-0.25 \text{cal} K^{-1}$

C. $-0.4 \text{cal} K^{-1}$

D. $-0.15 \text{cal} K^{-1}$

Answer: D

▶ Watch Video Solution

112. For the reaction

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

ΔH and ΔS are $-283 kJ$ and $-87 JK^{-1}$, respectively. It was intended to carry out this reaction at 1000,1500,3000, and 3500 K. At which of these temperatures would this reaction be thermodynamically spontaneous?
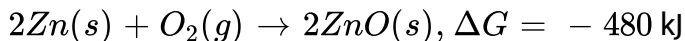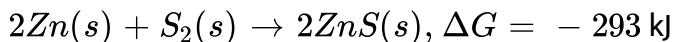
A. 1500 and 3500K

B. 3000 and 3500 K

C. 1000, 1500 and 3000 K
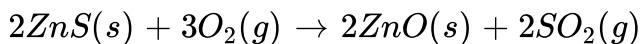
D. 1500, 3000 and 3500 K

Answer: C

113. The factor of ΔG values is important in metallurgy. The ΔG values

for the following reactions at 800ºC are given as :

$S_2(s) + 2O_2(g) \rightarrow 2SO_2(g), \Delta G = -544kJ$

$2Zn(s) + S_2(s) \rightarrow 2ZnS(s), \Delta G = -293$ kJ

$2Zn(s) + O_2(g) \rightarrow 2ZnO(s), \Delta G = -480$ kJ

Calculate the ΔG for the reaction:

$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$

A. $-357kJ$

B. $-731kJ$

C. $-773kJ$

D. $-229kJ$

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

A. $9.92 \times 10^5 Pa$

B. $11.094 \times 10^8 Pa$

C. $10.952 \times 10^7 Pa$

D. $9.92 \times 10^6 Pa$