CHEMISTRY

BOOKS - NTA MOCK TESTS

THERMODYNAMICS TEST-1

Single Choice

1. The S - S bond energy, if

$\Delta H_f^\circ(E_t - S - E_t) = -147$ mol, and

$\Delta H_f^\circ(E_t - S - S - E_t) = -202$ kJ/mol

$\Delta H_f^\circ S(g) = +233$ kJ/mol, is:

A. 268 kJ

B. 126 kJ

C. 278 kJ

D. 572 kJ

Answer: C

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2. The lattice energy of solid NaCl is 180 kcal/mol. The dissolution of the solid in water in the form of ions is endothermic to the extent of 1 kcal/mol. If the hydration energies of Na^+ and Cl^- are in the ratio $6:5$, what is the enthalpy of hydration of Nation ?

A. -8.5 kcal mol^{-1}

B. -97.64 kcal mol^{-1}

C. $+82.6$ kcal mol^{-1}

D. $+100$ kcal mol^{-1}

Answer: B

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3. Diborane is a potential rocket fuel which undergoes combustion according to the reaction:

$$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(s) + 3H_2O(g)$$

From the following data, calculate the enthalpy change

for the combustion of diborane.

$$2B\ (s) + \frac{3}{2}O_2\ (g) \longrightarrow B_2O_3\ (s), \quad \Delta H = -1273\ kJ\ mol^{-1}$$
$$H_2\ (g) + \frac{1}{2}O_2\ (g) \longrightarrow H_2O\ (l), \quad \Delta H = -286\ kJ\ mol^{-1}$$
$$H_2O\ (l) \longrightarrow H_2O\ (g), \quad \Delta H = 44\ kJ\ mol^{-1}$$
$$2B\ (s) + 3H_2\ (g) \longrightarrow B_2H_6\ (g), \quad \Delta H = 36\ kJ\ mol^{-1}$$

A. $-2035kJmol^{-1}$

B. -2045kj mol^{-1}

C. -2135kJ mol^{-1}

D. -2285kJ mol^{-1}

Answer: A

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4. 2 mol of an ideal gas at 27°C temperature is expanded reversibly from 2 L to 20 L. Find the entropy change. (R = 2 cal / mol K)

A. $9.2 cal K^{-1}$

B. $92.1 cal K^{-1}$

C. $46 cal K^{-1}$

D. $4.6 cal K^{-1}$

Answer: A

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5. The enthalpy of neutralisation of NH_4OH and CH_3COOH is -10.5 kcal mol^{-1} and enthalpy of neutralisation of CH_3COOH with strong base is -12.5 kcal mol^{-1}. The enthalpy of ionisation of NH_4OH will be:

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

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

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

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

Answer: C

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6. The enthalpy of hydrogenation of cyclohexene is -119.5kJ mol^{-1}. If resonance energy of benzene is -150.4kJ mol^{-1} its enthalpy of hydrogenation would be

A. -358.5kJ mol^{-1}

B. -508.9kJ mol^{-1}

C. -208.1kJ mol^{-1}

D. -269.9kJ mol^{-1}

Answer: C

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7. The bond dissociation energies of gaseous H_2, Cl_2 and HCl are 104, 58 and 103 kcal, respectively. The enthalpy of formation of HCl gas would be:

A. -44 kcal

B. -88 kcal

C. -22 kcal

D. -11 kcal

Answer: C

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8. The change in entropy of 2 moles of an ideal gas upon isothermal expansion at 243.6 K from 20 L to the state where pressure becomes 1 atm is (Given: In 2 = 0.693)

A. 1.385 cal/K

B. -1.2 cal/K

C. 1.2 cal/K

D. 2.77 cal/K

Answer: D

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9. The work done in an open vessel at 300 K, when 112 g iron reacts with dil. HCl is:

$\left(R = 2\text{cal mol}^{-1}K^{-1}\right)$

A. 1200 cal

B. 600 cal

C. 300 cal

D. 200 cal

Answer: A

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10. At 1000 K, from the data,

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g), \Delta_r H^\circ = -123.77 \text{kJ mol}^{-1}$

Substance	N_2	H_2	NH_3
C_p/R	3.5	3.5	4

The heat of formation of ammonia in kJ mol^{-1} at 300 K is:

A. -88.85

B. $+88.85$

C. -44.42

D. $+44.42$

Answer: C

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11. Enthalpy of atomization of $C_2H_6(g)$ and $C_3H_8(g)$ are 620 and $880kJ\text{mol}^{-1}$ respectively. The C-C and C-H. bond energies are respectively.

A. 80 and 60 kJ mol^{-1}

B. 80 and 90 kJ mol^{-1}

C. 70 and 90 kJ mol^{-1}

D. 200 and 80 kJ mol^{-1}

Answer: B

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12. On the basis of the following thermochemical data:

$\left[\Delta_f H^\circ \quad \text{of} \quad H^+(aq) = 0\right]$

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

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H^\circ = -286.02\ \text{kJ}$

What is the value of enthalpy of formation of OH^- at 25°C?

A. -22.88 kJ

B. -228.88 kJ

C. $+228.88$ kJ

D. -343.52 kJ

Answer: B

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13. The free energy change for the following reactions are given below:

$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l),$

$\Delta G^\circ = -1234$ kJ

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

$\Delta G^\circ = -394$ kJ

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

$\Delta G^\circ = -237$ kJ

What is the standard free energy change for the following reaction?

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

A. -209 kJ

B. -2259 kJ

C. $+2259$ kJ

D. 209 kJ

Answer: D

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14. 1 mole of H_2SO_4 is mixed with 2 moles of NaOH. The heat evolved will be:

A. 57.3 kJ

B. 2×57.3 kJ

C. $57.3/2$ kJ

D. Cannot be predicted

Answer: B

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15. The enthalpy of combustion of H_2, cyclohexene (C_6H_{10}) and cyclohexane (C_6H_{12}) are $-241, -3800$ and $-3920kJmol^{-1}$ respectively. The heat of hydrogenation of cyclohexene is:

A. 121kJ mol^{-1}

B. -121kJ mol^{-1}

C. $+242\text{kJ mol}^{-1}$

D. -242kJ mol^{-1}

Answer: B

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16. The heat of atomisation of PH_3 (g) is 228 kcal mol^{-1} and that of P_2H_4 (g) is 335 kcal mol^{-1}. The energy of P-P bond is:

A. 102 kcal mol^{-1}

B. 31 kcal mol^{-1}

C. 26 kcal mol^{-1}

D. 204 kcal mol^{-1}

Answer: B

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17. At what minimum pressure (in terms of kPa) of given volume of an ideal gas ($C_{p.m} = \frac{7}{2}R$), originally at 400 K and 100 kPa pressure, be irreversibly adiabatically compressed in order to raise its temperature to 600 K?

A. 362.5 kPa

B. 275.0 kPa

C. 437.5 kPa

D. 550.0 kPa

Answer: B

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18. 16 g oxygen gas expands at STP to occupy double of its original volume. The magnitude of work done during the process is:

A. 260 cal

B. 180 cal

C. 130 cal

D. 271.6 cal

Answer: D

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19. Calculate the enthalpy change when 50 mL of 0.01 M $Ca(OH)_2$, reacts with 25 mL of 0.01 M HCl. Given that, AH° of neutralization of a strong acid and a strong base is 140 kcal mol^{-1}.

A. 14 kcal

B. 35 cal

C. 10 cal

D. 7.5 cal

Answer: B

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20. If $\Delta_f H^\circ(C_2H_4)$ and $\Delta_f H^\circ(C_2H_6)$ are a and b kcal mol^{-1}, then, the heat of hydrogenation of C_2H_4 IS:

A. $a + b$

B. $a - b$

C. $b - a$

D. $a - 2b$

Answer: C

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21. The enthalpies of neutralization BOH 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 containing 1 mole of AOH and 1 mole of BOH, the enthalpy change was - 12500 cal / mol. In what ratio is the acid distributed between AOH and BOH respectively.

A. $2:1$

B. $2:3$

C. $1:2$

D. $3:2$

Answer: A

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22. In the conversion of limestone to lime, $CaCO_3(s) + CaO(s) + CO_2$ (g), the values of ΔH° and ΔS° are 179.1kJ mol^{-1} and $160.2JK^{-1}\text{mol}^{-1}$ respectively at 298 K and 1 bar. Assuming ΔH° and ΔS° remain constant with temperature, at which minimum temperature does the conversion of limestone to lime will be spontaneous ?

A. 1118 K

B. 1008 K

C. 1200 K

D. 845 K

Answer: A

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23. For an ideal gas, $\frac{C_{\mathrm{p.m}}}{C_{\mathrm{v.m}}} = \gamma$. The molecular mass of a gas is M, its specific heat capacity at constant volume is:

A. $\frac{R}{M(\gamma - 1)}$

B. $\frac{M}{R(\gamma - 1)}$

C. $\frac{\gamma RM}{\gamma - 1}$

D. $\frac{\gamma R}{M(\gamma - 1)}$

Answer: A

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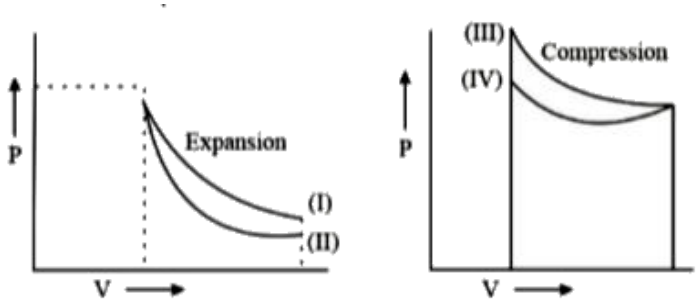
24. Which of the figures given below show the adiabatic process ?



A. I,III

B. I,III

C. II, IV

D. I,IV

Answer: A

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25. The value of $\log_{10}$ K for a reaction $A \rightarrow B$ is Given:

$\Delta_r H^{\circ}_{298K} = -54.07 kJ \text{mol}^{-1}$,

$\Delta_r S^{\circ}_{298K} = 10 JK^{-1} \text{mol}^{-1}$

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

$2.303 \times 8.314 \times 298 = 5705$

A. 5

B. 10

C. 95

D. 100

Answer: B

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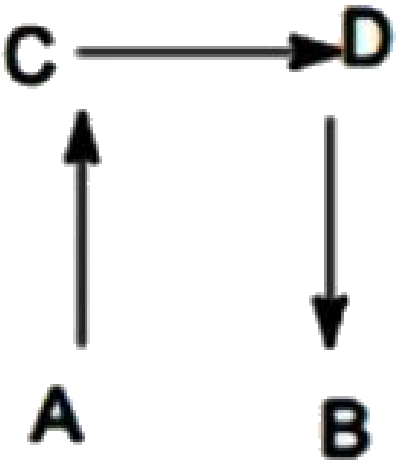
26. The direct conversion of A to B is difficult, hence, it is carried out by the following path:



Given:

$\Delta S_{A \to C} = 50$ c.u,

$\Delta S_{C \to D} = 30$ c.u.

$\Delta S_{B \to D} = 20$ c.u where e.u is the entropy unit.

Then, $\Delta S_{A \to B}$ is:

A. $+60$ eu

B. $+100$ e.u

C. -60 e.u

D. 100 e.u

Answer: A

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27. If ΔH is the change in enthalpy and ΔE, the change in internal energy accompanying a gaseous reaction, then:

A. ΔH is always greater than ΔE

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

C. ΔH is 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

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28. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litre.

ΔE for this process is:

(R = 2 cal $\mathrm{mol}^{-1} K^{-1}$)

A. 163.7 cal

B. Zero

C. 1381.1 cal

D. 9 litre atm

Answer: B

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29. The heat of formation of methane at constant pressure is 18500 Kcal at 25°C. What would be the heat of reaction at constant volume?

(Given: $C(s) + 2H_2 + CH_4 + 18500$ kcal, $Q_p = 18500$ cals, R = 2 kcal,

Q_p = Heat of reaction at constant pressure)

A. 19096 kcal

B. 18798 kcal

C. 18202 kcal

D. 17904 kcal

Answer: A

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30. The work done (in erg) for the reversible expansion of one mole of an ideal gas from a volume of 10 Litres to 20

Litres at 25°C is:

A. $2.303 \times 298 \times 0.082 \log 2$

B. $-298 \times 10^7 \times 8.314 \times 2.303 \log 2$

C. $-2.303 \times 298 \times 0.082 \log 0.5$

D. $2.303 \times 298 \times 2 \log 2$

Answer: B

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