

JEE MAIN : CHAPTER WISE TEST PAPER-5

SUBJECT :- CHEMISTRY

CLASS :- 11th

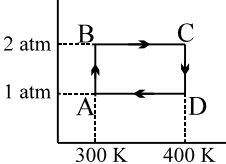
CHAPTER :- THERMODYNAMICS & THERMOCHEMISTRY

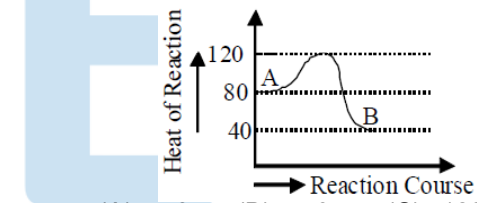
DATE.....

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SECTION.....

(SECTION-A)

1. What is $\Delta_r G$ (KJ/mole) for synthesis of ammonia at 298 K at following sets of partial pressure: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; $\Delta_r G^\circ = -33$ KJ/mole. [Take $R = 8.3$ J/K mole, $\log 2 = 0.3$; $\log 3 = 0.48$]
- | Gas | N_2 | H_2 | NH_3 |
|----------------|-------|-------|--------|
| Pressure (atm) | 1 | 3 | 0.02 |
- (A) + 6.5 (B) - 6.5
(C) + 60.5 (D) - 60.5
2. An adiabatic container having 10 mol of an ideal monoatomic gas with $P_1 = 1$ atm and initial temperature of 300 K. It is then surrounded with oil ($C_p = 2500$ J/K) at 300 K. The oil is heated by immersing a rod carrying 5 Amp current at 50 V for 15 sec. Simultaneously, the gas is compressed reversibly to $P_2 = 15.19$ bar. What is the final temperature of the gas? [Given $15^{-0.4} = 0.34$]
- (A) 866.2 K (B) 4563.2 K
(C) 6279.2 K (D) 782.5 K
3. What is the value of change in internal energy at 1 atm in the process $H_2O(l, 323\text{ K}) \longrightarrow H_2O(g, 473\text{ K})$
- Given: $C_p^{(H_2O,l)} = 75.3\text{ JK}^{-1}\text{ mol}^{-1}$;
 $C_p^{(H_2O,g)} = 33.314\text{ JK}^{-1}\text{ mol}^{-1}$
 ΔH_{vap} at 373 K = 40.7 kJ/mol
- (A) 109.1 kJ/mol (B) 37.6 kJ/mol
(C) 43.86 kJ/mol (D) 48.36 kJ/mol
4. Benzene burns according to the following equation
 $2C_6H_6(l) + 15O_2(g) \longrightarrow 12CO_2(g) + 6H_2O(l)$
 $\Delta H^\circ = -6542$ kJ
What is the ΔE° for the combustion of 1.5 mol of benzene
- (A) -3271 kJ (B) -9813 kJ
(C) -4906.5 kJ (D) None of these
5. Inversion temperature ($T_i = \frac{2a}{Rb}$) is defined as the temperature above which if gas is expanded adiabatically it gets warm up but if temperature of gas is lower than T_i then it will cool down. What will happen to a gas if it is adiabatically expanded at 50°C if its Boyle's temperature is 20°C
- (A) heating (B) cooling
(C) constant (D) None of these
6. The value of ΔG_f° of gaseous mercury is 31 K J/mole. At what total external pressure mercury start boiling at 25°C. [$R = 8.3$]
- (A) $10^{-5.44}$ (B) $10^{-12.5}$
(C) $10^{-6.52}$ (D) $10^{-3.12}$
7. Two moles of Helium gas undergo a cyclic process as shown in figure. Assuming gas to be ideal, what is the net work involved in the cyclic process?
- 
- (A) -100 R/n4 (B) +100R/n4
(C) +200R/n4 (D) -200R/n4
8. At 298 K, $\Delta H^\circ_{\text{combustion}}$ (sucrose) = -5737 KJ/mol & $\Delta G^\circ_{\text{combustion}}$ (sucrose) = -6333 KJ/mol. Estimate additional non-PV work that is obtained by raising temperature to 310 K. Assume $\Delta_r C_p = 0$ for this temperature change
- (A) 0 (B) 2 kJ/mol
(C) 24 kJ/mol (D) 23.07 kJ/mol
9. A reversible heat engine A (based on carnot cycle) absorbs heat from a reservoir at 1000K and rejects heat to a reservoir at T_2 . A second reversible engine B absorbs, the same amount of heat as rejected by the engine A, from the reservoir at T_2 and rejects energy to a reservoir at 360K. If the efficiencies of engines A and B are the same then the temperature T_2 is
- (A) 680 K (B) 640 K
(C) 600 K (D) none
10. Combustion of sucrose is used by aerobic organisms for providing energy for the life sustaining processes. 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 3.42 gm of sucrose
- Given : $\Delta H_{\text{combustion}}$ (sucrose) = - 6000 kJ mol⁻¹
 $\Delta S_{\text{combustion}}$ = 180 J/Kmol & Body temperature is 300 K.
- (A) 60 kJ (B) 59.46 kJ
(C) 0.54 kJ (D) 60.54 kJ

11. The enthalpies of all elements in their standard states are -
 (A) unity (B) zero
 (C) < 0 (D) > 0
12. The enthalpies of elements in their standard states are taken as zero. The enthalpy of formation of a compound :
 (A) is always negative
 (B) may be positive or negative
 (C) is always positive
 (D) is never negative
13. According to Hess's Law the thermal effect of a reaction depends on -
 (A) initial concentration of reactants
 (B) final condition of the reacting substance
 (C) intermediate states of a reaction
 (D) initial and final conditions of the reacting substances
14. For which of the following substances, the standard heat of formation is zero ?
 (A) C_(graphite) (B) C_(diamond)
 (C) CO₂ (D) O₃
15. Ammonium nitrate can decompose with explosion by the following reaction.
 $\text{NH}_4\text{NO}_3(\text{s}) \rightarrow \text{N}_2\text{O}(\text{g}) + 2\text{H}_2\text{O}(\text{l})$; $\Delta H = -37.0 \text{ kJ/mol}$
 Calculate the heat produced when 2.50 g of NH₄NO₃ decomposes -
 (A) 1.06 kJ (B) 0.96 kJ
 (C) 1.16 kJ (D) 1.26 kJ
16. For hypothetical reaction - $\text{A}(\text{g}) + \text{B}(\text{g}) \rightarrow \text{C}(\text{g}) + \text{D}(\text{g})$
 Which of the following statements is correct?
 (A) $H = E$ (B) $H > E$
 (C) $H < E$ (D) unpredictable
17. ΔH for $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$, is 176 kJ mol⁻¹ at 1240 K. The ΔU for the change is equal to :
 (A) 160 kJ (B) 165.6 kJ
 (C) 186.3 kJ (D) 180.0 kJ
18. For which of the following change $f' H_{\text{prod}} > f' H_{\text{react}}$?
 (A) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightarrow 2\text{HI}(\text{g})$
 (B) $\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 (C) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
 (D) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
19. The net heat change in a chemical reaction is same whether it is brought about in two or more different ways in one or several steps. It is known as -
 (A) Hess's law
 (B) Law of conservation of energy
 (C) Henry's law
 (D) Joule's principle
20. According to the diagram given below, the value of ΔH for conversion of A to B is -

 (A) -40 (B) +40 (C) -120 (D) +120

(SECTION-B)

21. The enthalpy of vaporization of liquid A at 42°C is 32 kJ/mole. If the normal boiling point of liquid is 47°C, using the given data, find $\Delta S_{\text{vaporisation}}$ at 42°C (in J/K mole)
 $C_p [A(l)] = 62 \text{ J/K mole}$
 $C_p [A(g)] = 30 \text{ J/K mole}$
 $\text{A}(l) \rightarrow \text{A}(g)$
 take $\ln \left(\frac{315}{320} \right) = \left(\frac{-5}{320} \right)$
22. Calcium oxide (CaO) prepared by reaction
 $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
 Calculate free energy change for the reaction ($\Delta_r G^\circ$) in kJ/mole at 300 K
 Given: $\Delta_f H^\circ(\text{CaO}, \text{s}) = -635 \text{ kJ/mole}$
 $\Delta_f H^\circ(\text{CO}_2, \text{g}) = -394 \text{ kJ/mole}$
 $\Delta_f H^\circ(\text{CaCO}_3, \text{s}) = -1207 \text{ kJ/mole}$
 $S^\circ(\text{CO}_2, \text{g}) = 214 \text{ J/K-mole}$
 $S^\circ(\text{CaO}, \text{s}) = 40 \text{ J/K-mole}$
 $S^\circ(\text{CaCO}_3, \text{s}) = 94 \text{ J/K-mole}$; all given data at 300 K
23. Calculate the mass of O₂ (g) in gm which can be produced from CaO (s) at 27°C by providing 159.3 kJ of heat at constant volume & temperature (300 K) conditions.
 Given: $\Delta_f H_{300}^\circ(\text{CaO}, \text{s}) = -636 \text{ kJ/mol}$; $M(\text{CaO}, \text{s}) = 56 \text{ g/mol}$; $R = 8.0 \text{ J/K-mol}$
24. The entropies of H₂(g) and H(g) are 130.6 and 114.6 J mol⁻¹ K⁻¹ respectively at 298 K. Using the data given below calculate the bond energy of H₂ (in kJ/mol) :
 $\text{H}_2(\text{g}) \rightarrow 2\text{H}(\text{g})$; $\Delta_r G^\circ = 406.62 \text{ kJ/mol}$
25. Calculate enthalpy change (in kcal) in adiabatic compression of 5 moles of ideal triatomic non-linear gas against a constant external pressure of 2 atm starting from initial pressure of 1 atm and initial temperature of 300 K. (Given : $R = 2 \text{ cal/mol.K}$ and vibrational degrees of freedom are inactive).

- 26.** Calculate the bond energy of C-H bond from the following data :
- (a) $C(s) + 2H_2(g) \longrightarrow CH_4(g)$; $\Delta H = -74.8 \text{ kJ}$
(b) $H_2(g) \longrightarrow 2H(g)$; $\Delta H = 435.4 \text{ kJ}$
(c) $C(s) \longrightarrow (g)$; $\Delta H = 718.4 \text{ kJ}$.
- 27.** Heat evolved in the reaction $H_2 + Cl_2 \rightarrow 2HCl$ is 182 kJ. Bond energies H - H = 430 kJ/mol, Cl - Cl = 242 kJ/mol. The H - Cl bond energy is-
- 28.** The heat of combustion of ethylene $C_2H_4(g)$ is - 1420 kJ/mol. The volume of C_2H_4 at NTP that would evolve 355 kJ on combustion is -
- 29.** The enthalpy of neutralisation of a weak acid in 1 M solution with a strong base is $-56.1 \text{ kJ mol}^{-1}$. If the enthalpy of ionization of the acid is 1.5 kJ mol^{-1} and enthalpy of neutralization of the strong acid with a strong base is $-57.3 \text{ kJ equivalent}^{-1}$, what is % ionization of the weak acid in molar solution (assume the acid to be monobasic) ?
- 30.** The enthalpy of neutralization of NH_4OH and CH_3COOH is -10.5 kcal/mol and enthalpy of neutralization of strong base and CH_3COOH is -12.5 kcal/mol . Calculate the enthalpy of dissociation of NH_4OH -

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