GOVERNMENT OF KARNATAKA
DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

18TH CROSS, MALLESHWARAM, BENGALURU – 560 012

CHAPTERWISE MULTIPLE CHOICE QUESTIONS FOR COMPETATIVE EXAM

SUBJECT: I PUC CHEMISTRY

NAME OF THE CHAPTER: UNIT: 05-THERMODYNAMICS

Synopsis

- An open system exchanges both matter and energy with its surroundings.
- A closed system can exchange energy but no the matter with its surroundings.
- An isolated system neither exchange energy nor matter with its surroundings.
- State variables depend only on the initial and final state of the system and not on the path. e.g: p, V, T, U, H, S
- Path dependent fuctions: work, heat.
- First law of thermodynamics: $\Delta U = q + w$.

  Work done by the system is negative. Work done on the system is positive.
- Intensive properties do not depend on the quantity of matter present in the system.
- Extensive properties depend on the quantity of matter present in the system.
- In an isothermal process, temperature remains constant.
- In an adiabatic process, heat remains constant.
- In an isobaric process, pressure remains constant.
- In an isochoric process, volume remains constant.
- Internal energy (U) is the stored or hidden energy of a system due to rotational, translational, vibrational motion of particles, electronic transitions etc.,
- Absolute value of internal energy cannot be measured accurately. Change in internal energy can be measured.
- Expansion of a gas in vacuum is called free expansion. No work is done during free expansion of an ideal gas whether the process is reversible or irreversible.
- Enthalpy of total heat content (H) is $H = U + pV$.
- Relationship between ΔH and ΔU

  $\Delta H = \Delta U + p\Delta V$

  $\Delta H = \Delta U + RT\Delta n$. Where Δn is the number of mole of gaseous products – number of mole of gaseous reactants.
- ΔH is negative for an exothermic reaction. Enthalpy of reactants is greater than the enthalpy of products.
- ΔH is positive for an endothermic reaction. Enthalpy of reactants is lesser than the enthalpy of products.

- $q = c\ m\ \Delta T$, q is heat, c is specific heat of a substance, m is mass of the substance and ΔT is change in temperature,
- $C_p - C_v = R$
- If the forward reaction is exothermic, the backward reaction is equally endothermic.
- Total enthalpy of the reaction remains the same whether the reaction is carried out in one step or in several steps.
- In case of diatomic molecules, the enthalpy of atomisation is same as the bond dissociation enthalpy.
- A spontaneous process is an irreversible process and may only be reversed by some external agency.
- ΔG is negative, the reaction is spontaneous. ΔG is positive, the reaction is non-spontaneous.

Introduction

1. Which one of the following is not concerned about thermodynamics?
   (a) driving force of a chemical reaction
   (b) energy changes of macroscopic systems.
   (c) rate of reaction
   (d) the extent to which reaction occurs.

6.1 Thermodynamic terms:

2. Read the following statements and select the correct option from the given choices.
   Statement-I : A reaction carried out in an open copper vessel forms a closed system.
   Statement-II : Surroundings is the portion of the universe excluding the system that can interact with the system.
   (a) Statements-I and II are incorrect
   (b) Statement-I is correct, statement-II is incorrect
   (c) Statement-I is incorrect, statement-II is correct
   (d) Statements-I and II are correct.

3. Which one of the following is a correct match with respect to the property mentioned with it?
   (a) State function : work
   (b) Path dependent function : internal energy
   (c) State variable : temperature
   (d) Adiabatic system : open system.

4. A: The energy of an isolated system is constant
   B: Energy can neither be created nor destroyed.
   C: Entropy of the universe is increasing continuously.
   The first law of thermodynamics is
   (a) Only A
   (b) Only B
   (c) A, B and C
   (d) A and B.

5. An example for a closed system is
   (a) human body
   (b) ice cubes kept in perfect thermos flask
   (c) reaction carried out in a test tube
   (d) reactants present in a closed copper vessel.

6. Path dependent function among the following is
   (a) internal energy
   (b) volume
   (c) temperature
   (d) work.

7. w is the amount of work done by the system and q is the amount of heat supplied to the system. The change in internal energy is
   (a) q + 2w
   (b) q - w
   (c) q – 3w
   (d) q + w.

8. According to IUPAC conventions,
   (a) work done by the system is negative
   (b) work done on the system is negative
   (c) work done by the system is positive
   (d) work done by the system is always zero.

9. Which of the following is the correct statement for the thermodynamic system?
   (a) the internal energy changes in all processes
   (b) internal energy and entropy are state functions
   (c) work is a state function
   (d) the work done in an adiabatic process is always zero. **(KCET 2026)**

6.2 Applications:

10. When an ideal gas expands in vacuum, change in enthalpy is
   (a) zero
   (b) > 0
   (c) < 0
   (d) 1

11. Identify the correct statement in the following .
   (a) In free expansion of an ideal gas, no work is done.
   (b) In isothermal and free expansion of an ideal gas, ΔU is not zero.
   (c) In a reversible process, the system and the surrounding are always not in equilibrium with each other.
   (d) $\Delta H = \Delta U$ for $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$.

12. Which of the following is an incorrect set for the property mentioned with it?
   (a) intensive properties: density, pressure, temperature
   (b) Extensive properties: internal energy, mass, volume
   (c) Endothermic process: melting of ice, sublimation of dry ice
   (d) Exothermic reaction: combustion, lattice enthalpy of solid NaCl.

13. . In an exothermic reaction, ΔH is negative. This indicates,
   (a) enthalpy of reactants is lesser than the enthalpy of products
   (b) enthalpy of reactants is greater than the enthalpy of products
   (c) enthalpy of reactants is equal to the enthalpy of products
   (d) enthalpy of products is greater than the enthalpy of reactants.

14. Two beakers filled with water are heated separately. First beaker is heated using Bunsen burner and the second beaker is heated using a spirit lamp. Thermometer kept in each beaker shows a reading of 98.7^0C when both of them start to boil. This indicates:
   (a) Temperature is a path dependent function.
   (b)Temperature is a state function.
   (c) Temperature is an extensive property
   (d) Temperature is dependent on volume of water taken in the beaker.

15. 1 mole of an ideal gas at an external pressure of 20 atm is compressed isothermally from 12 L to 2L at 300K. The values of w and ΔU are
   (a) +200 J and 0
   (b) +200 L atm and 0
   (c) -200L atm and 0
   (d) -200 J and 0.

16. For adiabatic expansion of ideal gas
   (a) $\Delta U \neq 0$
   (b) $\Delta U = w_{adiabatic}$
   (c) $w = 0$
   (d) $q \neq 0$.

17. In a process, 500 J of heat is absorbed by the system and 200J of work is done by the system. Δ U for the process is
(a) 100 J (b) 300J
(c) 700 J (d) 500 J.

18. Work done when 2 moles of an ideal gas expands reversibly and isothermally from a volume of 1 L to 10L at 300K is (R = 0.0083 kJ K^{-1} mol^{-1}).
(a) 0.115 kJ (b) 58.5 kJ
(c) 11.5 kJ (d) 5.8 kJ. **(KCET 2022)**

19. Given below are two statements.
Statement 1 : Adiabatic work done is positive when work is done on the system and internal energy of the system increases.
Statement 2 : No work is done during free expansion of an ideal gas.
In the light of the above statements, choose the correct answer from the options given below.
(a) Both statements 1 and 2 are false
(b) Statement 1 is true but statement 2 is false
(c) Statement 1 is false but statement 2 is true
(d) Both statements 1 and 2 are true. **(KCET 2025)**

6.3 Measurement of Δ U and Δ H: Calorimetry.

20. . The internal energy change can be found using,
(a) colorimeter (b) bomb calorimeter
(c) conductivity cell (d) potentiometer

21. The correct relationship between ΔH and ΔU for the combustion of methane gas is
(a) ΔH = ΔU (b) ΔH = ΔU + RT
(c) ΔH = ΔU –RT (d) ΔH = ΔU + 2RT

22. $C_6H_{6(l)} + 15/2\ O_{2\,(g)} \rightarrow 6CO_2(g) + 3H_2O_{(l)}$ was carried out in a bomb calorimeter at 298K and 1 atm. Δ U for the reaction is -3270716 J. Δ H for the reaction is
(a) -6272501 J (b) -3270726 J
(c) -3266999 J (d) -5241541 J.

23. A swimming pool contains 10^9 g of water. The amount of heat required to increase the temperature of this water from 20°C to 30°C is
(a) 4.18 X 10^9 J (b) 4.18 X 10^8 J
(c) 4.18 X 10^{10} J (d) 4.18 X 10^3J

6.4 Enthalpy change of a reaction- reaction enthalpy.

24. The standard state of a substance at a temperature is its state at pure form at a pressure:
(a) 1atm (b) 1 Pa
(c) 1 bar (d) 1 mm of Hg.

25. Δ_fH^o in kJ mol^{-1} for $CO_{2(g)}$, $CO_{(g)}$ and $H_2O_{(g)}$ are -393.5, -113.3 and -241.8 respectively. Enthalpy of the reaction $CO_{2(g)} + H_{2\,(g)} \rightarrow CO_{(g)} + H_2O_{(g)}$ is
(a) 28.4kJmol^{-1} (b) 18.4kJmol^{-1}
(c) 38.4kJmol^{-1} (d) -28.4kJmol^{-1}

26. Which one of the following does not influence the enthalpy of reaction?
(a) allotropic modifications of reactants
(b) quantities of reactants

(c) physical states of reactants and products
(d) time of reaction.

27. The enthalpy of vapourisation of a liquid is 25kJ mol^{-1} and the entropy change 50 J K^{-1}. The boiling point of the liquid is
(a) 500°C (b) 227°C
(c) 456K (d) 555K.

28. The amount of heat liberated when 50mL of 1 M hydrochloric acid is mixed with 50mL of 1M KOH is
(a) 2.86kJ (b) 57.3kJ
(c) 573kJ (d) 53J.

29. $\Delta_f H^0_{(H2O, l)} = -x$ $Jmol^{-1}$, $\Delta_f H^0_{(Fe2O3, s)} = -y$ $Jmol^{-1}$. Heat of reaction for the reaction $Fe_2O_{3\,(s)} + 3H_{2\,(g)} \rightarrow 2Fe_{(s)} + 3H_2O_{(l)}$ is
(a) -3x –y (b) +3x – y
(c) +3x +y (d) -3x + y

30. Which of the following always have a negative value ?
(a) heat of combustion (b) heat of formation
(c) heat of reaction (d) heat of solution.

6.5 Enthalpies of different types of reactions:

31. Enthalpy of combustion of butane is -2658kJ. If a family needs 15000kJ of energy per day for cooking, how long would the cylinder last. (Cylinder contains 11.2kg of butane).
(a) 34 days (b) 24days
(c) 12days (d) 50days.

32. Enthalpy of sublimation of a substance is equal to
(a) enthalpy of fusion
(b) enthalpy of vaporization
(c) enthalpy of fusion+ enthalpy of vapourisation
(d) twice the enthalpy of vapourisation.

33. Standard molar enthalpy of combustion of graphite is equal to
(a) standard molar enthalpy of formation of diamond
(b) standard molar enthalpy of combustion of diamond
(c) standard molar enthalpy of formation of carbon dioxide.
(d) standard molar enthalpy of decomposition of carbon dioxide.

34. A man coming out from a wash room has a film of water on his hand weighing 9g. The amount of heat required to just dry his hand in the drier is (Standard enthalpy of vapourisation of water is +40.66 kJ mol^{-1} at 373K).
(a) 40.66 kJ (b) 2 kJ
(c) 10 kJ (d) 20.33 kJ.

35. Bond dissociation enthalpy of $H_{2(g)}$ is +435 kJ mol^{-1}. Enthalpy of atomization of $H_{2(g)}$ is
(a) +217 kJ mol^{-1} (b) +435 kJ mol^{-1}
(c) -435 kJ mol^{-1} (d) -217 kJ mol^{-1}.

36. If the bond energies of H-H , Br-Br and H-Br are 433, 192 and 364 $kJmol^{-1}$ respectively, then ΔH^0 for the reaction : $H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$ is

(a) -261 kJ (b) +103 kJ
(c) +261 kJ (d) -103 kJ. **(KCET 2016)**

37. A : Entropy of a perfect crystalline solid at absolute zero approaches zero
B : For spontaneity of a reaction, $T\Delta S > \Delta H$
Among the two statements given above, identify the correct answer from the options given below.
(a) Both A and B are true (b) A is true but B is false
(c) Both A and B are false (d) A is false but B is true. **(KCET 2026)**

38. Lattice enthalpy for NaCl is +788 kJ mol^{-1} and $\Delta_{hyd}H^0$ = -784 kJmol^{-1}. Enthalpy of solution of NaCl is
(a) -572 kJ mol^{-1} (b) -4 kJ mol^{-1}
(c) +572 kJ mol^{-1} (d) +4 kJ mol^{-1} **(KCET 2023)**

6.6 Spontaneity:

39. At equilibrium,
(a) $\Delta H = -T\Delta S$ (b) $T\Delta H = \Delta S$
(c) $\Delta H = T\Delta S$ (d) $\Delta G = T\Delta H$

40. Both ΔH and ΔS for a reaction are positive.
a) Reaction is spontaneous at low temperatures
b) Reaction is non spontaneous at all temperatures
c) Reaction is spontaneous at high temperatures
d) Reaction is spontaneous at all temperatures.

41. The process is spontaneous at the given temperature, if
(a) ΔH is positive and ΔS is negative
(b) ΔH is negative and ΔS is positive
(c) ΔH is positive and ΔS is positive
(d) ΔH is positive and ΔS is equal to zero. **(KCET 2013)**

42. Standard Gibb's free energies of formation of all elementary substances are taken as
(a) zero (b) negative
(c) positive (d) one

43. Conversion of oxygen into ozone is non-spontaneous at
(a) all temperatures (b) high temperatures
(c) room temperature (d) low temperature **(KCET 2014)**

44. The value of entropy of solar system is
(a) increasing (b) decreasing
(c) constant (d) zero **(KCET 2013)**

45. Which of the following substances has highest entropy value at a temperature?
(a) water (b) graphite
(c) dihydrogen (d) diamond.

46. The SI unit of entropy is
(a) J $K^{-1}mol^{-1}$ (b) kJmol
(c) JK^{-1} mol (d) kJ mol^{-1}.

47. At 300K , enthalpy change for a reaction is 100 J mol^{-1} and the energy not available to do useful work is +5 J $K^{-1}mol^{-1}$. Net available energy to do useful work in this reaction is

(a) 50 J mol^{-1} (b) - 1400 J mol^{-1}
(c) +1400 J mol^{-1} (d) -100J mol^{-1}

48. Enthalpy of reactants is lesser than that of products in a reaction. Entropy increases largely during this reaction. Forward reaction is
(a) spontaneous at very low temperatures
(b) non spontaneous at very high temperature
(c) spontaneous at very high temperatures
(d) spontaneous at all temperatures.

49. The incorrect statement among the following is
(a) The entropy of the universe is constant.
(b) heat cannot be completely converted into work
(c) the absolute entropy of a perfect crystalline solid at absolute zero is zero
(d) the total energy of an isolated system remains constant.

50. A reaction has both ΔH and ΔS negative. The rate of reaction
(a) cannot be predicted for change in temperature
(b) increases with increase in temperature
(c) increases with decrease in temperature
(d) remains unaffected by change in temperarure. **(KCET 2017)**

51. The energy which is not available to do useful work is
(a) ΔH (b) ΔG
(c) ΔS (d) TΔS

52. In which of the following ΔS is negative?
(a) melting of ice
(b) decomposition of solid sodium hydrogen carbonate
(c) sublimation of iodine
(d) condensation of water vapour.

Answer key

1	2	3	4	5	6	7	8	9	10
c	c	c	d	d	d	b	a	b	a
11	12	13	14	15	16	17	18	19	20
a	d	b	b	c	b	b	c	d	b
21	22	23	24	25	26	27	28	29	30
c	b	c	c	c	d	b	a	d	a
31	32	33	34	35	36	37	38	39	40
a	c	c	d	b	d	a	d	c	c
41	42	43	44	45	46	47	48	49	50
b	a	a	a	c	a	b	c	a	c
51	52								
d	d								

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