K1 Level

MULTIPLE CHOICE QUESTIONS

1. The study of the flow of heat or any other form of energy in to or out of a system undergoing physical or chemical change is called

(a) thermochemistry (b) thermokinetics **(c)thermodynamics** (d) thermochemical studies

2. The third law of thermodynamics states that in the limit $T \rightarrow 0$

(a) G=0 (b) H=0 (c) V=0 **(d) S=0**

3. Planck proposed the relationship between the entropy of a system and the thermodynamic probability is given by the equation _____

(a)S=klnw (b) S=kw (c)S= -klnw (d) S=klnT

4. The vibrational partition function equation is given by _____

(a) $q_{vib} = 1/1-e^{-h\upsilon}/kT$ (b) $q_{vib} = 1/1+e^{-h\upsilon}/kT$ (c) $q_{vib} = 1/1+ e^{h\upsilon}/kT$ (d) $q_{vib} = 1/-1+e^{-h\upsilon}/kT$

5. The phosphorescence is otherwise known as ----------

(a) Electroluminescence **(b)delayed fluorescence** (c) bioluminescence (d) chemiluminescence

6. For an ideal gas , the fugacity is equal to pressure and _____

(a) f/p =1 (b) f/p=0 (c) f/p varies (d) f/p> 1

7. Which is the correct unit for entropy?

(a) kJ mol **(b) $J\ K^{-1}\ mol^{-1}$** (c) $J\ K^{-1}mol$ (d) $kJ\ mol^{-1}$.

8. The equation for the evaluation of β in M.B. distribution law is _____

(a) $\beta = 1/kT$ (b) $\beta = -1/kT$ (c) $\beta = kT$ (d) $\beta = 2/kT$

9. The expression for homonuclear diatomic molecule in Rotational partition function is given by _____

(a) $q_{rot} = 2I\ kT / \sigma\ h^2$ (b) $q_{rot} = 2I\ kT / h^2$ (c) $q_{rot} = 2\ kT / h^2$ (d) $q_{rot} = 2I\ k / hT$.

10. ---------- deals with the study of chemical reactions which are caused by the absorption of light radiations.

(a) thermodynamics **(b) photochemistry** (c)thermochemical reactions (d) thermal reactions

11. _____ is the measure of effective concentration of a species in a mixture.

(a) Activity (b) Fugacity (c) Partial pressure (d) Entropy

12. Mathematical probability always lies between _____.

(a) 0 and infinite **(b) 0 and 1** (c) - infinite and + infinite (d) 1 and infinite

13. The particles obeying Maxwel-Boltzmann statistics are called _____

(a) Maxwellons (b) Bosons (c) Fermions (d) Positrons

14. _____ relates the microscopic properties with macroscopic properties.

(a) Canonical ensembles **(b) Partition function**

(c) Entropy (d) Planck's quantum theory

15. _____ achieves the condition of producing an intense and coherent beam.

(a) Maser **(b) Laser** (c) Phototron (d) Cyclotron

16. The Boltzmann entropy equation is_____

(a) $dS = dq/T$ **(b) $S = K\ln w$** (c) $\Delta S = 0$ (d) $S = f(W)$

17. Striling's approximation ln N! =_____

(a) NlnN-N (b) N/2lnN+2 (c) lnN! (d) NlnN+N

18. The translational partition function (Q_{tr}) =_____

(a) q^N **(b) $[2\Pi mkT / h^2]^{3/2} . V$** (c) 1 (d) $\sum g_i e^{-E}i/_{KT}$

19. The electronic partition function of monoatomic gas value is _____

(a) 1 (b) 0 (c) ½ (d) ∞

20. What is the rate for intersystem crossing process?

(a) K_{ISC} $[S_0]$ **(b) K_{ISC} $[S_1]$** (c) K_{ISC} $[S_2]$ (d) K_{ISC} $[T_1]$

21. The fugacity coefficient value for an ideal gas_____

a) 3 b) 5 **c) 0** d) 1

22. What is the value of activity of solid in their standard state?

a) 1/2 (b) 0 **(c) 1** (d) ∞

23. In which of the following process, the process is always non-feasible?

a) $\Delta H > 0, \Delta S > 0$ b) $\Delta H < 0, \Delta S > 0$ c) $\Delta H > 0, \Delta S < 0$ d) $\Delta H < 0, \Delta S < 0$

24. The entropy of CO at absolute zero is_____

a) Positive **b) zero** c) increase d) decrease

25. The term used to define the phenomenon of emission of light in a chemical reaction_____

a) Chemical luminescence b) photo sensitization c) thermal reaction d) decomposition

26. The activities of liquids, solids and liquid solvents in pure state under 1 atm pressure is taken as\

(a) Unity at each temperature (b) Zero at each temperature

(c) Unity at absolute zero (d) Zero at all temperature

27. The phosphorescence is otherwise known as ----------

(a) Electroluminescence **(b)delayed fluorescence** (c) bioluminescence (d) chemiluminescence

28. Choose the residual entropy for solid N_2O

i) $3.3JK^{-1}$ ii) $4.4\ JK^{-1}$ **iii) $5.8\ JK^{-1}$** iv) $1\ JK^{-1}$

K2 Level

1. What do you understand by the term activity?

2. Define combination.

3. What are Legrangian multipliers?

4. Write the equation for the translational partition function.

5. What is Delayed fluorescence?

6. What is meant by fugacity?

7. Define statistical entropies.

8.What is the total probability of obtaining simultaneously the pair of ace and king from a shuffled deck of
52 cards?

9. Define molecular partition function.

10. What is quenching?

11. State Nernst heat theorem.
12. What do you meant by thermodynamic probability?
13. Define assembly.
14. What is maser?
15. Define the term statistical thermodynamics.
16. State partition function.
17. Write down the relation between enthalpy and partition function.

18. What is fugacity? How is fugacity related with chemical potential?
19. State that Lewis Randal rule.
20. Discuss about need for third law.
21. Write down the Boltzmann – plank equation.
22. Define the PK^* values in excited state.

23. Define chemical potential.

24. Write down the Gibbs – Helmholtz equation.

25. Write down the Boltzmann entropy equation.

26. Write the missing terms:

i) $dE = dq - ?$ ii) $G = H - ?$ iii) $? = E + PV$ iv) $A = ? - TS$

K3 Level

1. a) Explain the terms chemical potential and fugacity.

(OR)

b) Derive the variation of fugacity with temperature.

2. a) Describe the characteristics of Gaussian distribution curve.

(OR)

b) Discuss the Statistical meaning of third law of thermodynamics.

3. a) Explain Stirling's approximation.

(OR)

b) i) Define thermodynamic probability and give examples.

ii) If four oscillators are distributed among three energy levels such that there may no oscillator in E_0, 2 inE_1, 2 in E_2 . Calculate the number of complex ions.

4. a) Derive expression for vibrational partition function.

(OR)

b) Justify the effect of molecular symmetry on rotational partition function.

5. a) Explain the terms singlet state and triplet state.

(OR)

b) Illustrate the flash photolysis.

6. a) Explain the terms activity and activity coefficient.

(OR)

b) Give brief note on standard states.

7. a) State third law of thermodynamics and need for the third law .

(OR)

b) Explain the theory of permutation.

8. a) Evaluate α in Maxwell Boltzmann distribution law.

(OR)

b) Explain the thermodynamic probabilities of systems involving energy levels.

9. a) Describe the partition function and canonical ensemble.

(OR)

b) Derive the equation for translational partition function.

10. a) Explain the terms internal conversion and intersystem crossing.

(OR)

b) Construct the mechanism of photo physical kinetics of unimolecular processes.

11. (a) Explain the variation of activity with temperature and pressure.

{OR}

(b) Formulate the activity and activity coefficient.

12. (a) Explain III law of thermodynamics.

{OR}

(b) Discuss about the laws of probability.

13. (a) Derive the Boltzmann expression for entropy.

{OR}

(b) Derive the relation between partition function and heat capacity.

14. (a) Describe the applications of Maser

{OR}

(b) Discuss the applications of flash photolysis

15. (a) Describe the applications of Laser

{OR}

(b) Compare the important features of Maxwell-Boltzmann (M-B), Bose-Einstein (B-E) and Fermi- Dirac (F-D) Statistics.

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16. a) Explain the state of maximum thermodynamic probability.

(OR)

b) Describe the thermodynamic probability.

17. a) Derive the relation between the molecular partition function and canonical partition function.

(OR)

b) Prove that $Q_r = [8\pi^2 IkT/2h^2]$

18. a) What is an ensemble? Define micro canonical, canonical and grand canonical ensemble.

(OR)

b) Drive the relation between Internal energy (E) and partition function

19. a) Describe on the change of fugacity with temperature.

(OR)

b) Derive the Stern – Volmer equation.

20. a) Illustrate the relation between fugacity and activity coefficient of gas.

(OR)

b) Derive the Lewis Randal rule.

21. a) Describe about the activity and activity coefficient of solution.

(OR)

b) Describe thermodynamic quantities at absolute zero.

22. a)What is probability? Explain the laws of probability.

(OR)

b) Describe about theories of Permutation and Combination.

23. a) Explain the excited state dipole moment in photochemistry.

(OR)

b) Illustrate the geometry of some electronically excited molecules.

24. a) Explain the graphical method of determining the fugacity of gases.

(OR)

b) Discuss about activity coefficient of a gas.

25. a) Define the terms standard state for solute and explain how the activity co-efficient of a gas is expressed in terms of f and p.

(OR)

b) Explain the laws of photo chemistry.

26. a) Explain the term Chemical potential.

(OR)

b) Calculate the value of molar residual entropy for NO molecules at absolute zero.

27. a) Define activity. Discuss about activity coefficient of a gas. .

(OR)

b) Discuss about choice of the standard states.

K4 Level

1. Determine the fugacity of a gas from equation of state?
2. Describe the measurement of solvent activity from colligative properties.
3. Derive the Nernst heat theorem.
4. Explain in detail thermodynamic quantities at absolute zero temperature.
5. Derive the equation for states of maximum thermodynamic probability, $N_i=N/s$.
6. Evaluate β in Maxwell Boltzmann distribution law?
7. Explain SACKUR-TETRODE equation for the translational entropy of an ideal gas.
8. Explain the relations between total partition function of a molecule and the separate partition function.
9. Discuss on geometry of excited states with examples.
10. Describe the Jablonski diagram for depicting various photo physical processes.
11. Derive the equation of state for determining the fugacity of a gas.
12. Determine the activity of solute.
13. Explain additive and multiplicative laws of probability.
14. Derive the equation $Ni = gi.e^{-\alpha} . e^{-\beta\varepsilon i}$
15. Explain briefly any two apparent exceptions to the third law.
16. Differentiate the thermodynamic properties between ortho and para hydrogen.
17. Derive Stirling's approximation.
18. Derive an expression for the rotational partition function and rotational contribution to entropy.
19. Explain in detail Fluorescence and phosphorescence.
20. (i) A system of N particles has, among others, two energy levels with g1=2, g2=3, U1=41.84 kJ/mol and

    U2=58.58 kJ/mol. Calculate the ratio of the number of particles in the two energy states at 1000K. (5)

    (ii) Calculate the translational partition function for hydrogen atom at 3000 K confined to move in a box of

    Volume of 2.494 x 105 cm3. (5)
21. Explain the determination of fugacity from equations of state.
22. Derive Boltzmann – Planck equation.
23. Arrive the relation for evaluation of alpha and beta in M.B. distribution law.
24. Derive the expression for translational partition function.
25. Discuss Stern-Volmer equation and explain its significance.

26. Evaluate α and β term in Maxwell - Boltzmann distribution law.

27. Explain thermodynamic probabilities of system involving energy levels.

28. (i) Derive the thermodynamic function entropy (S) in terms of partition function. **(5)**

(ii) Derive the thermodynamic function heat capacity (C_p & C_v) in terms of partition function. **(5)**

29. Explain the effect of molecular symmetry on rotational partition function with ortho and Para hydrogen.

30. Explain: (i) Flash photolysis (ii) Delayed fluorescence.

31. Discuss briefly on the laser and its applications

32. State Nernst heat theorem. How does the Third law of thermodynamics follow from this theorem?

33. Determine the fugacity of gases by the following methods,

(i) Graphical method (ii) generalized method

34. Explain briefly on the variation of activity of a gas with Pressure and Temperature.

35. Describe about Distribution laws and illustrate the Gaussian distribution.

36. Determine the excited state activity constant (P_K^*). Explain with examples.

37. Discuss briefly on the types of photo physical pathways.

38. Discuss in detail the activity co-efficient of solution and derive an equation for the mean activity co-efficient of

an electrolyte.

39. Discuss briefly on the physical properties of excited state molecules.

40. Determine the fugacity of gases by graphical method.

41. Evaluate the activity and activity coefficient of solution

42. Determine the activity of solvent and solute by using vapour pressure method .

43. Explain briefly on the variation of activity coefficient of a gas with Pressure and Temperature.

44. Distinguish the absolute entropies of solids, liquids and gases

45. Describe about Distribution laws. Explain their types.