

Roll No. ....

**D-981**

**M. Sc. (Fourth Semester) (Main/ATKT)  
EXAMINATION, May-June, 2020**

CHEMISTRY

Paper Third (CH-21)

(Material and Nuclear Chemistry)

Time : Three Hours ] [ Maximum Marks : 80

Note : Attempt all Sections as directed.

Section—A 1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. The concept of entropy production in an irreversible thermodynamics can be expressed as :

(a)  $d_{\sigma} = dS + \frac{dq}{T}$

(b)  $d_{\sigma} = \frac{dq}{T}$

(c)  $d_{\sigma} = dS + dS_{rev}$

(d)  $d_{\sigma} = \frac{-dq}{T}$

2. The mass transfer process  $J_M = -D \frac{dc}{dx}$  is known as :

- (a) Fick's law  
(b) Onsager's law  
(c) Fourier's law  
(d) Newton's law

3. Which of the following statements is incorrect ?

- (a) Two simultaneous irreversible flows, provided they are independent of each other, can be described by appropriate phenomenological relations.  
(b) Onsager developed irreversible thermodynamics in 1931 for analyzing coupled irreversible flow.  
(c) Entropy of the system is an extensive property.  
(d) For an irreversible process the entropy production is zero while for a reversible process the entropy production is positive.

4. Which of the most important biological application of irreversible thermodynamics ?

- (a) Photosynthesis  
(b) Transport across biological membrane  
(c) Oxidation-Reduction  
(d) None of the above

P. T. O.

[ 3 ]

D-981

5. The irreversible phenomena can be expressed by the following linear phenomenological relation ( $X$  = force and  $J$  = flux) :

$$(a) \quad X_j = \sum_{j=1}^n L_{ij} J_j$$

$$(b) \quad L_{ij} = \left( \frac{\partial X_j}{\partial J_i} \right)_0$$

$$(c) \quad J_i = \sum_{j=1}^n L_{ij} X_j$$

$$(d) \quad L_j = \sum_{j=1}^n J_{ij} X_j$$

6. Who first used the term Nanotechnology ?

- (a) Richard Feynman
- (b) Norio Taniguchi
- (c) Eric Drexler
- (d) Sumio Tjijima

7. Which of the following is an example of Bottom-up approach for the synthesis of nanoparticles ?

- (a) Laser Ablation
- (b) Sputtering
- (c) Etching
- (d) Chemical vapour deposition

8. Which of the following is magnetic nanoparticle ?

- (a)  $Fe_3O_4$
- (b) CdS
- (c) ZnO
- (d) CdSe

[ 4 ]

D-981

9. Match the following :

Properties	Reason
(i) Lower melting point	(A) Huge surface energy
(ii) Optical properties	(B) Reduced imperfections
(iii) Magnetic	(C) Large fraction of surface atoms
(iv) Mechanical properties	(D) Surface plasmon resonance
(a) (i)-B, (ii)-D, (iii)-C, (iv)-A	
(b) (i)-A, (ii)-B, (iii)-D, (iv)-C	
(c) (i)-C, (ii)-D, (iii)-A, (iv)-B	
(d) (i)-A, (ii)-C, (iii)-D, (iv)-B	

10. The physical basis of Transmission Electron Microscopy (TEM) is :

- (a) Emission of electrons
- (b) Scattering of electrons
- (c) Physical interaction with sample
- (d) Light scattering fluctuations due to diffusion

11. Supramolecular chemistry is primarily concerned with :

- (a) Non-covalent bonding
- (b) Atomic forces
- (c) Covalent bonding
- (d) Thermodynamics

12. What type of guest would a crown ether be able to bind ?

- (a) Anions
- (b) Neutral species
- (c) Zwitterions
- (d) Cations

P. T. O.

[ 5 ]

D-981

13. The cyclodextrin contains a  $\alpha$ ,  $\beta$  and  $\gamma$ , number of glucose monomers at :
- (a) 1, 2, 3
  - (b) 8, 7, 6
  - (c) 6, 7, 8
  - (d) 5, 6, 7
14. In the crown ether 12-crown-4, how many atoms are there in the ring and how many are oxygen ?
- (a) 12 and 4
  - (b) 4 and 12
  - (c) 16 and 2
  - (d) 12 and 12
15. Which of the following statements are correct for the crown ether complexes ?
- (a) Binds selectivity  $K^+$  whose size matches that of the cavity.
  - (b) Cavity is polar, outside of complex is lipophilic.
  - (c) Complex is soluble in non-polar solvents.
  - (d) All the above statements are correct.
16. Which nuclei has the highest nuclear binding energy per nucleon ?
- (a)  $^{238}\text{U}$
  - (b)  $^{62}\text{Ni}$
  - (c)  $^4\text{He}$
  - (d)  $^{52}\text{Cr}$
17. Name the moderator used in the nuclear reactor ?
- (a) Graphite
  - (b) Plutonium
  - (c) Beryllium
  - (d) Thorium

P. T. O.

[ 6 ]

D-981

18. It is possible to understand nuclear fission on the basis of :
- (a) Proton-proton cycle
  - (b) Meson theory of nuclear forces
  - (c) Particle model
  - (d) Liquid drop model of nucleus
19. Which of the following isotopes has the shortest half-life ?
- (a) Carbon-14
  - (b) Fluorine-18
  - (c) Carbon-11
  - (d) Carbon-13
20. When the radioactive decay constant increases ?
- (a) The half-life increases
  - (b) The half-life decreases
  - (c) The half-life remains unchanged
  - (d) The half life first increases and then decreases

**Section—B**

2 each

**(Very Short Answer Type Questions)**

**Note :** Attempt all questions. Write answer in 2-3 sentences.

1. Write one postulate of non-equilibrium thermodynamics.
2. What is the relationship between coupled reactions and non-equilibrium thermodynamics ?
3. What are the influences of reducing agents for the synthesis of metallic nanoparticles ?
4. Write *two* important difference between SEM and TEM techniques.

[ 7 ]

D-981

5. Why cryptands are best receptors for spherical cations ?
6. Define molecular and supramolecular chemistry.
7. What is nuclear fusion reaction ?
8. What is the significance of magic numbers in nuclear chemistry ?

Section—C

3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. Show that in a two-flux two force systems where linear phenomenological relations are obeyed :

$$(L_{21} + L_{12})^2 < 4L_{11} L_{22}$$

where  $L_{12}$  are cross-phenomenological coefficient and  $L_{11}$  and  $L_{22}$  are straight coefficients.

2. Explain Prigogine's principle of minimum entropy production in non-equilibrium thermodynamics.
3. What are the characteristics of sol-gel method for the synthesis of ceramics ?
4. Write optical and electrical properties of nanoparticles.
5. What is molecular recognition ? Write *five* important factors of molecular recognition.
6. What are the intermolecular forces in supramolecules ?
7. Discuss the radiochemical principles involved in the use of radioactive tracers.
8. Write the application and limitation of semi-empirical mass equation.

Section—D

5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. What is phenomenological law ? Describe Onsager's reciprocity relations.

P. T. O.

[ 8 ]

D-981

Or

Discuss the application of non-equilibrium thermodynamics to biological membrane system and energetics of active transport.

2. Discuss different methods for the preparation of metallic and semiconductor nanomaterials.

Or

Discuss briefly applications of nanoparticles on the following areas :

(i) Electronics

(ii) Materials/chemicals

(iii) Biology/Medicine

3. Discuss the principle of supramolecular reactivity and catalysis. Give some examples.

Or

How to synthesize a macrocycle ? Discuss the design, principle and properties of cyclodextrin *or* cyclophanes.

4. Describe liquid drop model in terms of its analogy, semiempirical mass equation and mean binding energy. Write its merits and demerits.

Or

What do you understand by nuclear fission and chain reaction ? Explain the different components of a nuclear reactor.

D-981