



ஸ்ரீ-ல-ஸ்ரீ காசிவாசி சுவாமிநாத சுவாமிகள் கலைக் கல்லூரி  
தருமனந்தாள் - 612504

**S.K.S.S ARTS COLLEGE, THIRUPPANANDAL - 612504**



## **QUESTION BANK**

*Title of the Paper*

## **NUCLEAR CHEMISTRY**

**Course: III B.Sc. (CHE)**

Prepared by

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## MAJOR BASED ELECTIVE II

### SEMESTER VI

## NUCLEAR, INDUSTRIAL CHEMISTRY & METALLIC STATE

### UNIT I

#### NUCLEAR CHEMISTRY I

1.1 Introduction, nuclear structure – composition of the nucleus, subatomic particles, nuclear forces, nuclear stability – mass defect and binding energy, whole number rule and packing fraction, n-p ratio, odd even rules, nuclear models – liquid drop and shell models, isobars, isotones and isomers.

1.2 Isotopes – detection, physical and chemical methods of separation, isotopic constitution of elements.

1.3 Radioactivity – introduction – radioactive emanations – characteristics of  $\alpha$ ,  $\beta$  and  $\gamma$ -rays, disintegration theory, modes of decay-group displacement law, rate of integration and half-life period, disintegration series, Geiger-Nuttal rule.

### UNIT II

#### NUCLEAR CHEMISTRY II

2.1 Detection and measurement of radioactivity – Wilson cloud chamber, Geiger – Muller counter.

2.2 Particle accelerators – linear accelerator and cyclotron.

2.3 Artificial radioactivity – nuclear transformation – classification of nuclear reactions, fission – atom bomb, fusion – hydrogen bomb, Stellar energy – nuclear reactor – atomic power projects in India.

2.4 Applications of radioisotopes as tracers in reaction mechanism, medicine, agriculture, industry and carbon dating. Hazards of radiations.

### UNIT III

#### METALLIC STATE

3.1 Metallic bond : Packing of atoms in metals (BCC, CCP, HCP) electron gas, Pauling and band theories, structure of alloys, substitutional and interstitial solid solutions, Hume-Rothery ratios, crystal defects – stoichiometric and non- stoichiometric defects.

3.2 Semi conductors - intrinsic and extrinsic – n-type and p-type. Composition, properties, structure and uses in electronic industry.

## UNIT IV

### INORGANIC POLYMERS AND THERMO ANALYTICAL METHODS

- 4.1 Inorganic polymers – coordination polymers, metal alkyls, phosphonitrilic polymers.
- 4.2 Silicates – classification into discrete anions – one, two and three dimensional structures with typical examples.
- 4.3 Composition, properties and uses of beryl, asbestos, talc, mica, feldspar and zeolite.

## UNIT V

### INDUSTRIAL CHEMISTRY

- 5.1 Gaseous fuels : Natural gas, gobar gas, water gas, semi water gas, carburetted water gas, producer gas and liquified petroleum gas (LPG) – composition, manufacture and applications.
- 5.2 Fertilizers : Manufacture of nitrogen, phosphorus, potassium and mixed fertilizers, micro nutrients and their role in plant life.
- 5.3 Safety matches : Introduction, raw materials and manufacturing method.
- 5.4 Paints and varnishes : Definition, types and composition.
- 5.5 Glass : Composition, manufacture, types and uses.
- 5.6 Cement : Manufacture – wet and dry processes, composition and setting of cement.



## UNIT-I

### CHOOSE THE CORRECT ANSWER

- The "magic numbers" for atoms are
  - numbers of electrons that confer atomic stability.
  - numbers of protons or neutrons that confer nuclear stability.
  - n/p ratios that confer nuclear stability.
  - atomic masses that confer nuclear stability.
- Which of the following statements is true for a  $^{14}\text{C}$ ?
  - it has 6 protons and 6 neutrons
  - it has 12 protons and 12 neutrons
  - it has 12 protons and 8 neutrons
  - it has 6 protons and 8 neutrons
- Beta emission is associated with \_\_\_\_\_
  - conversion of a neutron to a proton.
  - decrease in mass number by 4 and atomic number by 2.
  - conversion of a proton to a neutron.
  - increase in mass number.
- Which type of radiation has the greatest penetration ability?
  - alpha
  - neutron
  - gamma
  - beta
- Which type of radiation does the most tissue damage, but only when the emitter is internally ingested?
  - (a).alpha
  - (b).neutron
  - (c). gamma
  - (d). beta
- Which isotope below has the highest nuclear binding energy per gram? No calculation is necessary.
  - $^4\text{He}$
  - $^{16}\text{O}$
  - $^{32}\text{S}$
  - $^{55}\text{Mn}$
- Nitrogen-12 is most likely to decay by
  - (a)gamma emission.
  - (b)alpha emission.
  - (c).beta emission.
  - (d).Either positron emission or electron capture
- In what type of radioactive decay does the atomic number of the product increase by one?
  - (a).alpha
  - (b).beta
  - (c).gamma
  - (d) positron emission
- Different isotopes of a particular element contain the same number of
  - (a).protons
  - (b)neutrons

- (c) (c).protons and neutrons  
(d) (d).subatomic particles
10. Which subatomic particle has the smallest mass?  
(a) (a)Neutron  
(b) (b).Electron  
(c) (c).Nucleus  
(d) Proton

**Answers: 1.(b), 2 (d), 3 (a), 4 (c), 5.(a), 6 (d), 7 (d), 8 (b), 9 (a), 10(d)**

### SHORT QUESTIONS (2 MARKS)

1. State and explain group displacement law and Geiger – Nuttall rule.
2. Define isobars and isotopes? Give examples.
3. What are the fundamental particles present in the atoms?
4. Define mass defect?
5. What is whole number rule?
6. Define half life period?
7. Define odd- even rule.
8. What is nuclear chemistry?
9. What is comment on K-capture?
10. What are isotones?

### PARAGRAPH QUESTIONS (5 MARKS)

11. What is n/p ratio? How does it determine the stability of the nucleus? Explain with diagram.
12. Tabulate the characteristics of  $\alpha$ ,  $\beta$  and  $\gamma$  rays.
13. Derive  $1 \text{ amu} = 931.5 \text{ Mev}$ .
14. Calculate the mass defect and binding energy per nucleon for  ${}_{6}\text{C}^{12}$  with actual mass of 12.0038 amu.  
(i) Mass of proton: 1.0084 amu  
(ii) Mass of neutron: 1.00894 amu.
15.  ${}_{39}\text{Au}^{198}$  on  $\beta$  bombarded with neutrons yields  ${}_{39}\text{Au}^{198}$ . The latter elements are radioactive and emits electron. Write the nuclear equations of the process.
16. Illustrate the nuclear transmutation brought about by protons and neutrons. Compare their relative merits.
17. Describe the phenomenon of artificial radio activity.
18. Half life period of an element is 22 years. How long will it takes for 50% of its weight to disintegrate?
19. Describe the nuclear changes during position emission and  $\beta$  emission.
20. Discuss about the nuclear stability with neat diagram.

### ESSAY QUESTIONS (10 MARKS)

21. What is meant by mass defect, Binding energy and packing fraction?
22. Describe the detection and methods of separation of isotopes briefly.
23. Explain the following :  
(i) Liquid drop model.  
(ii) Magic numbers.

24. Describe the group displacement law and rate of integration.
25. Explain the characteristics of  $\alpha$ ,  $\beta$  and  $\gamma$  rays.
26. Explain the chemical methods of separation of isotopes.
27. Explain the modes of decay of radio activity.
28. Explain the Geiger nuttall rule.
29. Explain the nuclear structure and composition of the nucleus.
30. Discuss about disintegration series.

## UNIT - II

### CHOOSE THE CORRECT ANSWER (1 MARK)

1. The isotope Ti-48 is produced by the alpha decay of which of the following:
  - (a)  $^{53}\text{Mn}$
  - (b)  $^{54}\text{Cr}$
  - (c)  $^{52}\text{Cr}$
  - (d)  $^{53}\text{V}$ .
2. Nuclear fission produces energy because
  - (a) neutrons are produced.
  - b. the total mass of the products is less than that of the reactants.
  - c. the total mass of the products is more than that of the reactants.
  - d. it is a very powerful chemical reaction.
3. When  $^{235}\text{U}$  is bombarded with one neutron, fission occurs and the products are three neutrons,  $^{94}\text{Kr}$ , and
  - (a)  $^{139}\text{Ba}$
  - (b)  $^{141}\text{Ba}$
  - (c)  $^{139}\text{Ce}$
  - (d)  $^{139}\text{Xe}$
4. Nuclear fusion produces energy because
  - (a) (a).neutrons are produced.
  - (b) (b).the total mass of the products is less than that of the reactants.
  - (c) (c).the total mass of the products is more than that of the reactants.
  - (d) (d).it is a very powerful chemical reaction.
5. Which radioisotopes of carbon are used in carbon dating?
  - (a) carbon -12
  - (b) carbon - 13
  - (c) carbon -14
  - (d) carbon -12 and 14
6. Radiometric dating is possible because the rates of decay of radioactive isotopes
  - (a) vary widely
  - (b) change from place to place
  - (c) are constant
  - (d) change over time
7. when the nucleus of an atom decays spontaneously it's called

- a. Relative dating
  - b. Deposition
  - c. Radioactivity
  - d. Erosion
8. In living things, what is the sources of the carbon- 14 that is used in radiocarbon dating
    - (a) carbonic acid in caves
    - (b) carbon di oxide in the atmosphere
    - (c) carbon di oxide in rocks
    - (d) carbon di oxide in water
  9. the time takes for 50% of nuclei in a radioactive sample to decay to its stable isotope is called
    - (a) the daughter product
    - (b) the half- life
    - (c) the half -time
    - (d) geological time
  10. In the nuclear reaction here, which of the following is the missing nuclear product?
    - a.  $N^{14}_5 B^{10} + {}_2 He^4 \rightarrow {}_1 H^1 + ?$
    - b.  $(a)_7 N^{21}$
    - c.  ${}_7 {}_6 C^{14}$
    - d.  ${}_7 N^{13}$

**Answer: 1.(c), 2 (b), 3 (a), 4 (b), 5 (c), 6 (c), 7(c), 8(b), 9(b), 10 (b)**

#### SHORT QUESTIONS (2 MARKS)

11. What is stellar energy?
12. What is meant by nuclear transformation?
13. What is group displacement law?
14. What are predicting the radioactive series of Ra -226.
15. What is fusion with examples?
16. What is nuclear fission with examples?
17. Define hydrogen bond.
18. Define atom bond.
19. What is carbon dating?
20. What is artificial radio activity?

#### PARAGRAPH QUESTIONS (5 MARKS)

21. Give a brief account on :
  - (i) Atomic power projects in India and
  - (ii) Cyclotron.
22. Discuss the detection and measurement of radio activity any one method.
23. Explain radio carbon dating.
24. Write a brief account on the application of radio isotopes in medicine.
25. Write short notes on uses of isotopes.

26. Discuss the principle of isotopic dilution analysis.
27. What is meant by tracer elements? Write notes on used of (radio active) isotopes of traces.
28. Mention the application of nuclear energy.
29. Explain the appropriate examples distinguish between nuclear fusion and fission.
30. How is the age of wood determined by radio activity?

### ESSAY QUESTIONS (10 MARKS)

31. Give the application of radio isotopes in medicine.
32. Illustrate with an examples nuclear fusion reaction. Explain how nuclear energy is released by nuclear fusion reaction. Indicate it's importance.
33. Explain application of radio isotopes as traces with examples.
34. Give an account of radioactive  $^{14}\text{C}$  dating technique; Write a brief note on  $^{14}\text{C}$  dating of the age of the oracles etc.
35. Write notes on disposal of low level, intermediate level and high level radioactive waste.
36. Explain the application of isotopes in agriculture.
37. Explain the classification of nuclear reaction.
38. Explain the steller energy and nuclear reaction.
39. Explain the hazards of radiations.
40. Describe about particle accelerators with any one method.

### UNIT - III

#### CHOOSE THE CORRECT ANSWER (1 MARK)

1. The property of metals by which they can be beaten into the thin sheets is called
  - (a) malleability
  - (b) ductility
  - (c) conduction
  - (d) expansion
2. Which one of the following is metal?
  - (a) C
  - (b) N
  - (c) Na
  - (d) O
3. Which one of the following is a good conductor of electricity?
  - (a) Iron
  - (b) plastic
  - (c) wood
  - (d) glass
4. which gas are produced when metal react with acids
  - (a)  $\text{O}_2$
  - (b)  $\text{N}_2$
  - (c)  $\text{H}_2$
  - (d)  $\text{CO}_2$
5. semiconductor is formed by \_\_\_\_\_ bonds



- (a) covalent  
(b) electrovalent  
(c) coordinate  
(d) none of the above
6. A semiconductor has \_\_\_\_\_ temperature co-efficient of resistance  
a. Positive  
b. Zero  
c. Negative  
d. None of the above
7. The most commonly used semiconductor is  
(a) germanium  
(b) silicon  
(c) carbon  
(d) sulphur
8. An n-type semiconductor is \_\_\_\_\_  
(a) Positively charge  
(b) Negatively charge  
(c) Electrically neutral  
(d) None of the above
9. In an intrinsic semiconductors, the number of free electrons  
(a) equals the no of holes  
(b) Is greater than the number of holes  
(c) is less than the number of holes  
(d) none of the above
10. Intrinsic semiconductors, at room temperature will have \_\_\_\_\_ available for conduction  
(a) electrons  
(b) holes  
(c) both electrons and holes  
(d) none of the above

**Answers: 1.(a), 2 (c), 3 (a), 4 (c), 5 (a), 6 (c), 7(b), 8(b), 9 (a), 10 (c)**

**SHORT QUESTIONS (2 MARKS)**

11. What is meant by crystal defects? How are they classified?  
12. Define the structure of BCC crystal system.  
13. Define radius ratio. Give its uses.  
14. Define point group and symmetry element.  
15. What is metallic bond?  
16. What are p- type conductor .Give examples?  
17. Discuss the nature of metallic bond.  
18. What are semi conductors?  
19. What are the types of semi conductor?  
20. Define electron gas theory.

### PARAGRAPH QUESTIONS (5 MARKS)

21. What are Hume – Rothery ratio's? Give examples.
22. Write a short note on interstitial solid solutions and metallic bond.
23. Explain the structure of ZnS.
24. Write a brief account of crystal defects.
25. Write short notes on metal bond.
26. Draw the arrangement of atoms in CCP crystal system.
27. Write notes on: Interstitial solid solutions.
28. Write notes on P- type semi conductors.
29. Discuss the nature of metallic bond.
30. Distinguish between intrinsic and extrinsic semi conductors. Give examples.

### ESSAY QUESTIONS (10 MARKS)

31. Explain about the bond theory of solids
32. Explain the structure of alloys and crystal defects.
33. What are semi conductors? How are they categorized?
34. Explain substitution solid solution with examples.
35. Write notes on N –type semi conductors.
36. Explain the uses of semi conductors in electronic industry.
37. Discuss the nature of metallic bond.
38. Give an account of the Pauling's (resonance) theory of recording the binding of metal atom in metallic crystal.
39. Explain the properties of metals by bond theory of metallic bond.
40. Give an account of the different type of semi conductors.

### UNIT - IV

### CHOOSE THE CORRECT ANSWER (1 MARKS)

1. The different monomers are arranged alternatively in
  - (a) alternate straight chain polymers
  - (b) regular straight chain copolymers
  - (c) straight chain polymers
  - (d) cross linked polymers
2. The word "polymer" meant for material made from
  - (a) single entity
  - (b) two entities
  - (c) multiple entities
  - (d) any entity
3. One of the characteristic properties of polymer material
  - (a) high temperature stability
  - (b) high mechanical strength
  - (c) high elongation
  - (d) low hardness
4. polymer are \_\_\_\_\_ in nature
  - (a) organic

- (b) inorganic  
(c) both (a) and (b)  
(d) none of these
5. These polymers cannot be recycled  
(a) thermoplastic  
(b) thermosets  
(c) elastomers  
(d) all polymers
6. thermal analysis of define as  
(a) measurement of concentration of materials as a function of temperature  
(b) Measurement of solubility of materials as a function of temperature  
(c) measurement of physical properties of materials as a function of temperature  
(d) measurement of line position of crystals as a function of temperature
7. Which of the following method can be used for the measurement change in weight of the oxysalts?  
(a) thermoelectric analysis  
(b) wagner analysis  
(c) stockbarger analysis  
(d) thermal analysis
8. Which of the following is an alumino silicates?  
(a) steatite  
(b) cordierite  
(c) Forsterite  
(d) porcelain
9. Which of the following are magnesium silicates?  
(a) porcelain  
(b) earthenware  
(c) stoneware  
(d) steatite
10. In zeolite process, the exchange of takes place  
(a) anion  
(b) cation  
(c) both (a) and (b)  
(d) no ion exchange

**Answers: 1.(a), 2 (c), 3 (c), 4 (c), 5(b), 6 (c), 7 (d), 8(a), 9 (d), 10 (c)**

**SHORT QUESTIONS (2 MARKS)**

11. What are coordination polymers? Give examples.  
12. List out the properties and uses of zeolite.  
13. What are metal alkyls? Give one examples.  
14. What are the primary and micro nutrients?  
15. Define structure of silicates.  
16. What are states the composition structure of beryl.

17. What about the occurrence of mica and indiga.
18. Define structure of zeolite.
19. What are the types of silicates .Give examples?
20. What are asbestos. Give examples?

**PARAGRAPH QUESTIONS (5 MARKS)**

21. Describe the composition properties and uses of mica.
22. What are phosphonitric polymers? How are they synthesized? List out its application.
23. Give a brief account of coordination polymers.
24. Give an account of silicates with layer and three dimension structure.
25. Write a note an application of Zeolite.
26. Write about preparation and uses of beryl.
27. Describe the properties of asbestos on the basis of its structure.
28. Give a four structure of silicates.
29. Discuss the structural features of the silicates and Zeolite.
30. Describe the principle of zeolites as water softners.

**(10 MARKS ESSAY QUESTIONS)**

31. Explain about the composition, properties, structure and uses of talc.
32. Give a brief account of phosphonitric polymers and their special merits.
33. Bring out the differences in the structure between mica and feldspar.
34. Discuss the structure and properties of beryl.
35. Describe the composition, properties, structure and uses of beryl.
36. Compare any three types of silicates with structure.
37. State the composition structure, properties and uses of asbestos.
38. Explain about the composition, properties, structure and uses of feldspar.
39. State the composition structure, properties and uses of zeolite.
40. Explain inorganic polymers with examples.

**UNIT - V**

**CHOOSE THE CORRECT ANSWER (1 MARK)**

1. Which fuels are either natural or artificial fuels?
  - (a) gaseous fuels
  - (b) solid fuels
  - (c) liquids fuels
  - (d) nuclear fuels
2. Which gaseous fuel has very low heating value?
  - (a) blast furnace gas
  - (b) coke oven gas
  - (c) water gas
  - (d) mond gas
3. Which gaseous fuel is obtained by partial combustion of coke?
  - (a) coke oven gas

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- (b) producer gas  
(c) coal gas  
(d) blast furnace gas
4. Nitrogenous fertilizer is required  
(a) during the early stage of growth to promote development of stem and leaves  
(b) for accelerating fruit formation in latter stage of growth  
(c) to lessen the effect of excessive potash application  
(d) none of these
5. Catalyst used in Haber's process for ammonia production is  
(a) reduced iron oxide  
(b) nickel  
(c) vanadium pentoxide  
(d) silica gel
6. Ammonium sulphate fertilizer is  
(a) the highest concentration nitrogenous fertilizer  
(b) the best fertilizer for paddy  
(c) a basic fertilizer  
(d) a neutral fertilizer
7. Superphosphate is manufactured by reacting phosphate rock with  
(a) acetic acid  
(b) sulphuric acid  
(c) aluminium chloride  
(d) none of the above
8. The old paint coating cannot be removed by  
(a) low expansion type  
(b) low electrical loss type  
(c) sealing type  
(d) ultraviolet transmitting type
9. Cement is a material with  
(a) adhesive properties  
(b) cohesive properties  
(c) both (a) and (b)  
(d) none of the above
10. What is the kovera type of glass?  
(a) low expansion type  
(b) low electrical loss type  
(c) sealing type  
(d) ultraviolet transmitting type

**Answers 1 (a), 2 (a), 3 (b), 4 (a), 5 (a), 6(b), 7 (d), 8 (d), 9 (b), 10 (c)**

### **SHORT QUESTIONS (2 MARKS)**

11. What are the four types of pollutants? Give examples.  
12. How is  $\text{Pb}(\text{C}_2\text{H}_5)_4$  minimize air pollution?

13. How is water gas manufactured? Mention it's any two uses.
14. Define paint and varnish.
15. What is natural gas?
16. What is meant by setting of cement?
17. What are the uses of paints?
18. What is glass?
19. What is the composition of ordinary glass?
20. How is paint manufactured?

**PARAGRAPH QUESTIONS (5 MARKS)**

21. How is water gas prepared?
22. How paint is manufactured?
23. What are the requisites of good fuels? Give the advantages of gases fuels.
24. Explain LPG and its advantages.
25. What are fertilizers? How are the classified? Give examples.
26. How is glass manufactured on large scale? Explain the types of glasses and uses.
27. Write short notes on varieties of paint?
28. Write notes on special glasses.
29. What are the four type's pollutants? Give examples.
30. How is Pb (C<sub>2</sub>H<sub>5</sub>) minimizing the pollution?

**ESSAY QUESTIONS (10 MARKS)**

31. Explain the composition manufactured and application of gobar gas and producer gas.
32. Explain the manufactured of cement by wet process with neat.
33. Explain the types of paints.
34. Write short notes on types of glasses.
35. How paint is manufactured?
36. How is water gas prepared?
37. Explain about the natural gas.
38. Explain the LPG and its advantages.
39. Explain manufactured of cement and try process.
40. What are the requests of good fuels? Give the advantages of gases fuels.

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