

Total No. of Printed Pages: 08

No. of Questions : 50

**Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar**  
**PET 2024 (9044) Doctor of Philosophy(Nanotechnology)**

(To be filled by the Candidate)

Candidate Seat Number  
(As per Admit card)

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OMR Sheet Number

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Invigilator's signature with Date

Candidate's Seat No. in Words : \_\_\_\_\_

Name of the Center : \_\_\_\_\_

Paper Code &amp; Name of Examination : 9044 - Doctor of Philosophy(Nanotechnology)

Date: 03/10/2024

PET 2024 - EXAMINATION

Time: One Hours

Total Marks: 100

**Important Instructions for the candidate**

- Write your seat number and OMR Sheet number on the question paper in the earmarked space
- This question paper carries Fifty (50) Multiple-choice type questions and each question carries 2 Marks
- At the commencement of examination, the question paper will be given to the student.
- Each question has four alternative responses marked (A) (B) (C) and (D). You have to darken the circle as indicated below on the correct response against each question  
Example: where (C) is correct answer

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- Your responses to the answer are to be indicated in the OMR Sheet. If you mark at any place other than in the circle in the OMR Sheet it will not be evaluated.
- Rough work is to be done at the end of this question paper.
- You have to return OMR answer sheet and question paper to the invigilator at the end of examination compulsorily and must not carry with you outside the examination hall.
- Use only Black / Blue ball point pen
- Use of any type of calculator or log table etc. is prohibited.
- There is no negative marking for incorrect answers

**विद्यार्थ्यांसाठी महत्त्वाच्या सूचना**

- परीक्षार्थींनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोपऱ्यात तसेच आपणास दिलेल्या उत्तर पत्रिकेचा क्रमांक त्याखाली लिहावा.
- या प्रश्नपत्रिकेतील सर्व प्रश्न सोडवणे अनिवार्य आहे.
- परीक्षा सुरु झाल्यावर विद्यार्थ्यांला प्रश्नपत्रिका दिली जाईल.
- प्रत्येक प्रश्नासाठी (A) (B) (C) (D) अशी चार विकल्प उत्तरे दिली आहेत, त्यातील योग्य उत्तराचा रकाना खाली दर्शविल्याप्रमाणे ठळकपणे काळा निळा करावा.  
उदा: जर (C) हे उत्तर योग्य असेल तर

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- या प्रश्नपत्रिकेतील प्रश्नांची उत्तरे ओएमआर उत्तर पत्रिकेतच दर्शवावीत इतर ठिकाणी लिहिलेली उत्तरे तपासली जाणार नाहीत.
- प्रश्नपत्रिकाच्या शेवटी कोऱ्या जागेवरच कच्चे काम करावे
- परीक्षा संपल्यानंतर विद्यार्थ्यांनी मूळ ओ. एम. आर उत्तरपत्रिका पर्यवेक्षकाकडे परत करणे आवश्यक आहे तथापि प्रश्नपत्रिका व ओ. एम. आर. उत्तरपत्रिका आपल्याबरोबर नेण्यास विद्यार्थ्यांला परवानगी नाही.
- फक्त काळ्या किंवा निळ्या बॉलपेनचाच वापर करावा
- कॅल्क्युलेटर किंवा लॉग टेबल वापरण्यास परवानगी नाही
- चुकीच्या उत्तरासाठी गुण कपात केली जाणार नाही

- | Q. No. | Question  |
|--------|---|
| 1.     | Which of the following is the most appropriate approach to formulate a research hypothesis in experimental nanotechnology?<br>(A) Conducting a literature review and identifying a gap in existing research<br>(B) Developing a hypothesis solely based on intuition and personal experience<br>(C) Adopting a hypothesis from a well-established research area without modification<br>(D) Using historical trends in a different field to predict outcomes in nanoscience |
| 2.     | Which of the following is not a component of a research proposal?<br>(A) Data analysis<br>(B) Literature review<br>(C) Introduction<br>(D) Research methodology   |
| 3.     | What is the primary purpose of using statistical sampling techniques in nanoscience research involving large datasets?<br>(A) To selectively focus on favorable data points for better outcomes<br>(B) To reduce the cost of experiments by limiting the number of samples tested<br>(C) To generalize findings from a representative subset of data to the entire population<br>(D) To enhance the accuracy of results by analyzing every possible data point              |
| 4.     | Which of the following is a non-probabilistic sampling technique that might be used when selecting nanoparticle samples for a pilot study in exploratory research?<br>(A) Cluster sampling<br>(B) Snowball sampling<br>(C) Simple random sampling<br>(D) Stratified sampling  |
| 5.     | In designing a research project on the application of nanomaterials for water purification, what is the primary ethical consideration researchers should address?<br>(A) Selecting a topic that has the highest commercial potential<br>(B) Avoiding excessive spending of research grants<br>(C) Ensuring reproducibility of experimental results<br>(D) Assessing potential environmental and health impacts of nanomaterials   |
| 6.     | Which of the following is the least important step when defining a research problem in Nanoscience?<br>(A) Conducting experiments to validate the research problem<br>(B) Consulting with experts in the discipline<br>(C) Identifying knowledge gaps in the field<br>(D) Reviewing related literature  |
| 7.     | In hypothesis formulation for nanotechnology research, which of the following best describes a null hypothesis?<br>(A) A hypothesis derived from a previous theoretical framework<br>(B) A hypothesis that must be proven correct to validate the research findings<br>(C) A hypothesis that suggests no relationship between two variables in a study<br>(D) A hypothesis that predicts a significant effect of nanomaterials on biological systems                        |

8. While defining a research problem in nanoscience, a researcher should avoid:
- (A) Addressing a research problem that challenges established scientific theories
  - (B) Using multiple approaches to analyze the problem
  - (C) Developing a problem that aligns with the current trends in the field
  - (D) Focusing on a problem that is too broad to address
9. Plagiarism in research is
- (A) Creative use of previous data
  - (B) Referring for new data and working over it with new objective
  - (C) Copying unscrupulously and making use of it
  - (D) Copying and citing
10. Which of the following is considered a serious violation of research ethics in scientific publication?
- (A) Fabricating data
  - (B) Conducting a peer review
  - (C) Citing relevant literature
  - (D) Acknowledging funding sources
11. Which of the following is not a characteristic of a good research hypothesis in nanotechnology research?
- (A) Logical consistency with existing theory
  - (B) Specificity
  - (C) Testability
  - (D) Generality to cover all aspects of the field
12. The term "conflict of interest" in scientific research refers to:
- (A) A difference in interpretation of results
  - (B) A disagreement between co-authors
  - (C) A dispute with the peer reviewers
  - (D) A situation where personal or financial interests could influence the research
13. When refining a research problem for a study on nanomaterial synthesis, which of the following should be considered as a critical component?
- (A) The ease of publication of the research in high-impact journals
  - (B) The scalability of the synthesis process for industrial use
  - (C) The commercial profitability of the research outcomes
  - (D) The theoretical implications of the nanomaterial's structure
14. Which of the following is most appropriate for collecting data in a study focused on the atomic-scale interaction of nanomaterials?
- (A) Survey method
  - (B) Focus group discussion
  - (C) Case study analysis
  - (D) Experimental method using scanning electron microscopy (SEM)

15. Which of the following is the correct sequence of steps in the research process?  
 (A) Data collection → Hypothesis formulation → Literature review → Data analysis  
 (B) Hypothesis formulation → Literature review → Data collection → Data analysis  
 (C) Literature review → Hypothesis formulation → Data collection → Data analysis  
 (D) Data collection → Literature review → Hypothesis formulation → Data analysis
16. Which data collection method is best suited for real-time monitoring of nanoparticle behavior in a fluid medium?  
 (A) Chronological data recording  
 (B) Field observation  
 (C) Historical data analysis  
 (D) In-situ characterization using Dynamic Light Scattering (DLS)
17. In nanotechnology research, which of the following techniques is classified as a primary method of data collection?  
 (A) Literature review  
 (B) Atomic Force Microscopy (AFM) imaging  
 (C) Patent database analysis  
 (D) Computational simulation
18. Which of the following sampling methods is most appropriate when analyzing a heterogeneous mixture of nanomaterials with varying particle sizes?  
 (A) Stratified sampling  
 (B) Convenience sampling  
 (C) Random sampling  
 (D) Systematic sampling
19. Which qualitative data collection method is least applicable in a nanotechnology research project?  
 (A) Focus group discussions among interdisciplinary researchers  
 (B) Experimental design involving nanomaterial synthesis  
 (C) Literature analysis of previous studies  
 (D) Interviews with research experts
20. Which of the following is NOT typically included in the methodology section of a research proposal?  
 (A) Experimental design  
 (B) Expected outcomes  
 (C) Sampling methods  
 (D) Data collection techniques
21. Patent protects.....  
 (A) Invention  
 (B) Discovery  
 (C) Published Research Work  
 (D) Both Discovery and Invention
22. If a frequency distribution has some extreme scores, then appropriate measure of variability will be .....  
 (A) Range  
 (B) Quartile Deviation  
 (C) Average Deviation  
 (D) Standard Deviation
23. In a research proposal, the term "literature review" refers to:  
 (A) A critical evaluation of existing research relevant to the proposed study  
 (B) A comprehensive analysis of experimental results  
 (C) A detailed summary of all studies conducted on the topic  
 (D) A chronological account of the history of the research area

24. Which of the following is the most appropriate sequence for writing a research report?  
 (A) Abstract → Introduction → Methodology → Results → Discussion → Conclusion  
 (B) Abstract → Literature Review → Methodology → Results → Conclusion  
 (C) Introduction → Abstract → Methodology → Results → Literature Review  
 (D) Abstract → Methodology → Results → Conclusion → Literature Review
25. Which of the following statements regarding crystal defects is correct?  
 (A) Frenkel defects occur when atoms are displaced to interstitial sites, leaving vacancies behind.  
 (B) Schottky defects involve the creation of excess cations on the surface of the crystal.  
 (C) Anti-site defects are caused by atoms moving from their regular lattice positions to the grain boundaries.  
 (D) Interstitial defects involve the replacement of atoms by smaller impurities in the host lattice.
26. Which of the following characterization techniques is most suitable for determining the size distribution of nanoparticles?  
 (A) Transmission electron microscopy (TEM)      (B) Scanning tunneling microscopy (STM)  
 (C) Dynamic light scattering (DLS)                (D) X-ray diffraction (XRD)
27. The electrical conductivity of a solid-state material depends on which of the following factors?  
 (A) The number of grain boundaries present  
 (B) The size of the bandgap between the conduction and valence bands  
 (C) The vibrational modes of the lattice  
 (D) All of the above
28. Which of the following properties is typically enhanced when a material is reduced to the nanoscale?  
 (A) Melting point                                        (B) Thermal stability  
 (C) Surface-to-volume ratio                        (D) Electrical resistivity
29. Which of the following properties of nanoparticles significantly differ from their bulk counterparts?  
 (A) Melting point                                        (B) Electrical conductivity  
 (C) Catalytic activity                                    (D) All of the above
30. What is the primary factor responsible for quantum confinement effects in nanoparticles?  
 (A) Surface energy  
 (B) Increased surface area-to-volume ratio  
 (C) Lattice defects  
 (D) Reduced size of particles to below the de Broglie wavelength
31. In the synthesis of metal nanoparticles via chemical reduction, which of the following serves as a common reducing agent?  
 (A) Sodium citrate                                      (B) Sodium borohydride  
 (C) Hydrazine    (D) All of the above

32. Which of the following techniques is most suitable for characterizing the surface morphology of nanostructures at the atomic level?  
 (A) Atomic force microscopy (AFM) (B) X-ray diffraction (XRD)  
 (C) Transmission electron microscopy (TEM) (D) Scanning tunneling microscopy (STM)
33. Which of the following nanomaterials is widely used as an electrocatalyst in fuel cells due to its high surface area and excellent conductivity?  
 (A) Silver nanoparticles (B) Zinc oxide nanowires  
 (C) Carbon nanotubes (D) Gold nanorods
34. Which of the following nanomaterials is widely used for drug delivery due to its biocompatibility and ability to encapsulate both hydrophobic and hydrophilic drugs?  
 (A) Gold nanoparticles (B) Liposomes  
 (C) Carbon quantum dots (D) Magnetic nanoparticles
35. Which property of quantum dots makes them particularly useful in bioimaging applications?  
 (A) High melting point (B) Tunable fluorescence emission  
 (C) High magnetic susceptibility (D) Strong catalytic activity
36. What is the primary mechanism by which nanoparticle-mediated hyperthermia is used to treat cancer?  
 (A) Nanoparticles generate heat when exposed to a magnetic field, killing cancer cells.  
 (B) Nanoparticles release cytotoxic chemicals upon light activation.  
 (C) Nanoparticles induce an immune response to attack cancer cells.  
 (D) Nanoparticles absorb X-rays, causing DNA damage.
37. Which of the following nanomaterials has shown promise in biosensing applications due to its high surface area and excellent electrical properties?  
 (A) Zinc oxide nanowires (B) Silicon nanoparticles  
 (C) Graphene (D) Silver nanoclusters
38. Which of the following best describes the role of nanoscale biomaterials in tissue engineering?  
 (A) Delivering genetic material to modify tissue function  
 (B) Providing mechanical support and promoting cell proliferation for tissue regeneration  
 (C) Enhancing the immune response to eliminate diseased tissues  
 (D) Acting as antibiotics to kill harmful bacteria in tissues
39. Which type of nanomaterial is commonly used in Proton Exchange Membrane (PEM) fuel cells to enhance the performance of the electrodes?  
 (A) Gold nanoparticles (B) Silicon nanowires  
 (C) Platinum nanoparticles (D) Graphene oxide
40. Which of the following nanomaterials is most effective in enhancing the efficiency of dye-sensitized solar cells (DSSCs)?  
 (A) Fullerene (C<sub>60</sub>) (B) Silver nanoparticles  
 (C) Zinc oxide nanorods (D) TiO<sub>2</sub> nanoparticles

41. Which nanomaterial is often used for contrast enhancement in magnetic resonance imaging (MRI) for biomedical applications?  
 (A) Iron oxide nanoparticles (B) Carbon quantum dots  
 (C) Titanium dioxide nanospheres (D) Cadmium selenide (CdSe) nanoparticles
42. Which of the following properties of carbon nanotubes makes them ideal for use in field emission displays (FEDs)?  
 (A) High thermal conductivity (B) Low work function  
 (C) High aspect ratio (D) All of the above
43. Which type of carbon nanotube structure is metallic in nature and has potential applications in nanoelectronics as interconnects?  
 (A) Zigzag CNTs (B) Armchair CNTs  
 (C) Chiral CNTs (D) Helical CNTs
44. What is the primary challenge in using single-walled carbon nanotubes (SWCNTs) for semiconductor devices?  
 (A) The difficulty in selectively producing semiconducting or metallic CNTs  
 (B) Their instability in ambient conditions  
 (C) Their high thermal conductivity  
 (D) Their small diameter leading to quantum effects
45. In which of the following biomedical applications are carbon nanotubes most effectively utilized?  
 (A) Tissue engineering scaffolds (B) MRI contrast agents  
 (C) Targeted drug delivery (D) All of the above
46. What is the major advantage of using carbon nanotubes in energy storage devices such as supercapacitors?  
 (A) High surface area and electrical conductivity  
 (B) Low cost and ease of synthesis  
 (C) High density of states at the Fermi level  
 (D) Their ability to act as ionic conductors
47. Which of the following properties of nanoparticles primarily influences their cytotoxicity in biological systems?  
 (A) Surface charge (B) Size and shape  
 (C) Chemical composition (D) All of the above
48. Which of the following factors does not significantly impact the biodistribution of nanoparticles in vivo?  
 (A) Temperature of the environment (B) Species and strain of the test animal  
 (C) Route of administration (D) Particle size and surface modification
49. What is the fundamental challenge of molecular manufacturing in terms of thermodynamics?  
 (A) Maximizing the chemical potential of reactants  
 (B) Stabilizing metastable states in molecular systems  
 (C) Minimizing entropy production during molecular assembly  
 (D) Overcoming van der Waals forces

50. Which of the following statements best describes molecular assemblers in the context of molecular nanotechnology?
- (A) Molecular assemblers are nano-sized robots that operate independently without external control.
  - (B) Molecular assemblers are theoretical devices capable of positioning molecules with atomic precision.
  - (C) Molecular assemblers are devices that self-replicate by copying themselves without requiring raw materials.
  - (D) Molecular assemblers are used to accelerate chemical reactions without the need for catalysts.

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