Unit 8.3. MCQs Set 1

Results

#1. Q1. Nanoparticles typically have at least one dimension in the size range of:

☐
(A). 1–100 nm
☐
(B). 1–10 µm
☐
(C). 1–100 µm
☐
(D). 10–100 mm

Nanomaterials are generally defined as having at least one dimension below 100 nm.

#2. Q2. Which of the following best describes the quantum size effect in nanoparticles?

☐
(A). No change in properties versus bulk
☐
(B). Electrical conductivity is unaffected by size
☐
(C). Altered electronic and optical properties due to confinement at the nanoscale
☐
(D). Only found in organic molecules

At the nanoscale, quantum confinement alters the electronic states, impacting optical and electronic behavior.

#3. Q3. “Bhasma” in some Ayurvedic contexts can be considered nano because:

☐
(A). It is always purely macroscale
☐
(B). These calcined metal/mineral particles often reach sub-100 nm sizes after repeated processing
☐
(C). No involvement in nanoscience
☐
(D). It never has any metal content

Traditional processes such as mardanā and puṭa can reduce particle sizes into the nanoscale, possibly altering their

properties.

#4. Q4. Green nanotechnology emphasizes:

☐
(A). Toxic and harsh chemical methods for NP synthesis
☐
(B). Environmentally friendly approaches like plant extracts or microbial routes for nanoparticle synthesis
☐
(C). Using purely inorganic solvents
☐
(D). Only physical top-down methods

Green nanotechnology employs eco-friendly methods to synthesize nanoparticles, reducing harmful byproducts.

#5. Q5. Metal nanoparticles like gold or silver can show distinct color due to:

☐
(A). Light scattering by large particles
☐
(B). Surface plasmon resonance, where conduction electrons resonate with incident light
☐
(C). Intrinsic fluorescence of gold atoms
☐
(D). Only chemical pigments

Surface plasmon resonance causes metal nanoparticles (e.g., gold) to exhibit vivid colors depending on their size and shape.

#6. Q6. “Carbon nanotubes” are classified as:

☐
(A). A type of metal oxide
☐
(B). Graphene sheets rolled into cylindrical structures
☐
(C). Bulk carbon rods
☐
(D). Aggregated carbon black

Carbon nanotubes consist of rolled graphene sheets and exhibit unique electrical and mechanical properties.

#7. Q7. Top-down approach to nanomaterial synthesis might involve:

☐
(A). Self-assembly of molecules
☐
(B). Physical milling or lithography to break bulk material into nanoscale particles
☐
(C). Chemical precipitation using biomolecules
☐
(D). Thermal evaporation in a closed system

Top-down methods rely on physical processes like milling or lithography to reduce bulk materials to nanoscale dimensions.

#8. Q8. Bottom-up approach typically:

☐
(A). None
☐
(B). Builds nanoparticles by assembling atoms or molecules through chemical or biosynthetic processes

☐
(C). Uses only mechanical grinding
☐
(D). Relies on spontaneous aggregation of large particles

Bottom-up synthesis forms nanoparticles via chemical reactions or self-assembly, starting at the atomic or molecular level.

#9. Q9. Using plant extracts to reduce metal ions into nanoparticles is an example of:

☐
(A). A purely physical method
☐
(B). A biosynthetic or green synthesis method
☐
(C). A toxic chemical reduction process
☐
(D). Nanoparticle annealing

Green synthesis uses biomolecules found in plant extracts as natural reducing agents to form nanoparticles in an environmentally friendly way.

#10. Q10. “Molecular basis of biosynthesis” of nanomaterials might refer to:

☐
(A). None
☐
(B). The role of enzymes or phytochemicals in reducing metal salts and capping the resulting nanoparticles
☐
(C). The use of high temperatures to melt metals
☐
(D). Laser ablation of bulk materials

Biological molecules such as enzymes and polyphenols not only reduce metal ions but also act as capping agents, influencing nanoparticle shape and stability.

#11. Q11. Transmission Electron Microscope (TEM) characterizes nanoparticles by:

☐
(A). Observing optical spectra
☐
(B). Passing electrons through thin samples to reveal high-resolution internal structures
☐
(C). Scanning the surface with a laser
☐
(D). Measuring magnetic fields

TEM allows visualization of nanoparticles at high resolution, providing details on internal structure and morphology.

#12. Q12. Scanning Electron Microscope (SEM) does:

☐
(A). None
☐
(B). Scans the sample surface with a focused electron beam, providing detailed topographical images
☐
(C). Uses X-rays to determine composition
☐
(D). Measures ultraviolet light absorption

SEM provides topographical images by scanning surfaces with an electron beam.

#13. Q13. Fluorescence microscopy in nanotech might be used to:

☐
(A). None
☐
(B). Visualize fluorescently labeled nanoparticles in biological samples
☐
(C). Measure electrical conductivity
☐
(D). Determine nanoparticle mass

Fluorescence microscopy is used to image nanoparticles that have been tagged with fluorescent molecules in cells or tissues.

#14. Q14. Atomic Force Microscope (AFM) works by:

☐
(A). None
☐
(B). Scanning the surface with a sharp probe to produce a 3D topographical map
☐
(C). Transmitting light through nanoparticles
☐
(D). Capturing X-ray diffraction patterns

AFM employs a nanoscale tip that scans over a sample surface, measuring force interactions to create a detailed topographical map.

#15. Q15. Energy-dispersive X-ray spectroscopy (EDX) identifies:

☐
(A). Optical absorption bands
☐
(B). Elemental composition via characteristic X-rays emitted from the sample
☐
(C). Neuronal activity
☐
(D). Magnetic properties

EDX, often coupled with electron microscopy, detects characteristic X-rays to identify elemental composition.

#16. Q16. UV–visible absorption is often used to:

☐
(A). None
☐
(B). Assess size- and shape-dependent plasmon resonance peaks in metal nanoparticles and determine their concentration
☐
(C). Measure thermal conductivity
☐
(D). Analyze nuclear magnetic resonance

UV–vis spectroscopy is employed to study the plasmon resonance properties of metal nanoparticles, which depend on their size and shape.

#17. Q17. Photoluminescence can measure:

☐
(A). None
☐

(B). The emission properties of quantum dots or other fluorescent nanomaterials
☐
(C). The bulk density of materials
☐
(D). Infrared absorption spectra

Photoluminescence examines light emission from nanoparticles, revealing size-dependent optical properties.

#18. Q18. Fourier-transform infrared spectroscopy (FTIR) helps find:

☐
(A). None
☐
(B). The functional groups on nanoparticle surfaces by identifying vibrational modes of chemical bonds
☐
(C). Electron mobility
☐
(D). Magnetic susceptibility

FTIR spectroscopy detects the vibrational transitions of chemical bonds, providing information on surface ligands.

#19. Q19. Atomic Absorption Spectroscopy (AAS) is used for:

☐
(A). None
☐
(B). Quantifying metal content in a sample by measuring light absorbed by vaporized atoms
☐
(C). Imaging the sample at high resolution
☐
(D). Determining crystal structure

AAS quantifies metal concentrations by analyzing the absorption of specific wavelengths by vaporized atoms.

#20. Q20. Dynamic Light Scattering (DLS) determines:

☐
(A). None
☐
(B). The particle size distribution in a colloidal suspension based on Brownian motion analysis
☐
(C). The electrical resistance of nanoparticles
☐
(D). The chemical composition

DLS measures the fluctuation of scattered light due to Brownian motion, inferring the hydrodynamic diameter of nanoparticles.

#21. Q21. Nanomaterials in biosensors can:

☐
(A). None
☐
(B). Enhance detection sensitivity via signal amplification mechanisms (e.g., gold NP-labeled antibodies)
☐
(C). Lower sensor specificity
☐
(D). Increase electrical noise

Nanomaterials offer high surface area and unique optical/electrical properties that can amplify biosensor signals.

#22. Q22. A typical advantage of nanomaterials in drug delivery is:

☐
(A). No difference from macroscale carriers
☐
(B). High surface area and the ability to target and release drugs in a controlled manner
☐
(C). Immediate uncontrolled release
☐
(D). Inability to cross cell membranes

Nanocarriers enhance drug solubility, targeting, and controlled release compared to larger particles.

#23. Q23. “Green nanotechnology” can reduce toxicity by:

☐
(A). None
☐
(B). Avoiding harsh chemicals and using eco-friendly reducing agents from biological sources
☐
(C). Applying high heat methods
☐
(D). Using acid-based syntheses exclusively

Green nanotechnology relies on natural, benign reagents (e.g., plant extracts) to synthesize nanoparticles, reducing harmful byproducts.

#24. Q24. Interaction of nanomaterials with biological systems depends on:

☐
(A). None
☐
(B). Their size, shape, surface charge, functional groups, and the formation of a protein corona in biological fluids
☐
(C). Only the core material
☐
(D). Unchanging physical properties

The interaction and fate of nanomaterials in biological systems are influenced by their physicochemical properties and any proteins that adsorb on their surface.

#25. Q25. Silver nanoparticles are widely studied for:

☐
(A). None
☐
(B). Their antimicrobial properties, which arise from their ability to disrupt microbial membranes and cellular functions
☐
(C). Their use in solar panels exclusively
☐
(D). Their inert nature

Silver nanoparticles are known for their broad-spectrum antimicrobial activity.

#26. Q26. Gold nanoparticles can be used in hyperthermia therapy because:

☐
(A). None
☐
(B). They efficiently absorb near-infrared light and convert it to heat, enabling localized tumor destruction
☐
(C). They degrade rapidly in tissues

☐
(D). They emit ultraviolet light

Gold nanoparticles absorb near-infrared light via surface plasmon resonance and convert it into heat, useful for killing cancer cells.

#27. Q27. Carbon-based nanomaterials like fullerenes or graphene can serve as drug carriers by:

☐
(A). None
☐
(B). Being functionalized to load drugs or targeting molecules due to their large surface area and unique chemistry
☐
(C). Only being used as fillers
☐
(D). Their inability to interact with biological targets

Their modifiable surfaces and large area make carbon-based nanomaterials excellent candidates for targeted drug delivery.

#28. Q28. Nanocapsules or liposomes in pharmaceutics:

☐
(A). None
☐
(B). Encase drugs within a bilayer or polymer shell, enhancing stability and controlled release
☐
(C). Are unstable structures
☐
(D). Do not interact with cells

Nanocapsules and liposomes protect encapsulated drugs from degradation and allow targeted, controlled release.

#29. Q29. “Bhasma” usage in Ayurveda might exhibit unique properties at the nanoscale, possibly:

☐
(A). None
☐
(B). Increased surface reactivity and altered bioavailability compared to bulk materials
☐
(C). Being identical to their micro-scale forms
☐
(D). Losing all medicinal properties

Traditional processing can reduce particle size to the nanoscale, altering dissolution rates, reactivity, and biological effects.

#30. Q30. Characterizing Ayurvedic “rasaśastra” products as nanomaterials may require:

☐
(A). None
☐
(B). Techniques such as TEM, SEM, XRD, and DLS to confirm their nanoscale dimensions and composition
☐
(C). Sole reliance on optical microscopy
☐
(D). Only chemical assays

A combination of microscopic, diffraction, and light scattering techniques is essential to verify nanoparticle characteristics.

#31. Q31. The molecular basis of nano-formulations often includes:

☐
(A). None
☐
(B). Understanding surface chemistry and functional groups that allow self-assembly or targeted binding
☐
(C). Merely focusing on core composition
☐
(D). Exclusive use of inorganic materials

The self-assembly and targeting of nanosystems are driven by surface chemistries and the presence of specific functional groups.

#32. Q32. The “sol-gel” method for nanoparticle synthesis involves:

☐
(A). None
☐
(B). Hydrolysis and condensation of precursors that transition from a sol to a gel state, ultimately yielding nanoparticles
☐
(C). Grinding bulk material
☐
(D). Thermal evaporation only

The sol-gel process is a chemical method that produces nanomaterials from a colloidal solution through hydrolysis and condensation reactions.

#33. Q33. Nanorods versus nanospheres might differ mainly in:

☐
(A). None
☐
(B). Their aspect ratio, where nanorods are elongated and may exhibit distinct optical properties
☐
(C). Their elemental composition
☐
(D). Their thermal stability only

The shape of nanoparticles, such as rods versus spheres, significantly influences their optical and physical properties.

#34. Q34. Electrospinning can create:

☐
(A). None
☐
(B). Nanofibers from polymer solutions using high voltage to draw thin fibers
☐
(C). Bulk fibers only
☐
(D). Nanorods

Electrospinning is a technique for producing nanoscale fibers from polymer solutions under high voltage.

#35. Q35. Hydrothermal synthesis typically uses:

☐
(A). None
☐
(B). High-pressure and high-temperature aqueous conditions to form nanocrystals with controlled morphology
☐
(C). Only room temperature conditions

☐
(D). Mechanical milling

Hydrothermal synthesis employs water under high pressure and temperature to produce well-defined nanomaterials.

#36. Q36. Laser ablation for nanoparticle synthesis is:

☐
(A). None
☐
(B). A top-down process in which a pulsed laser vaporizes material from a target in a liquid, forming nanoparticles
☐
(C). A chemical reduction process
☐
(D). Exclusively a biological method

Laser ablation uses high-energy laser pulses to ablate material from a target, generating nanoparticles in a liquid medium.

#37. Q37. In the color of gold nanoparticles, the phenomenon is due to:

☐
(A). None
☐
(B). Surface plasmon resonance, resulting in unique absorption and scattering properties
☐
(C). Intrinsic pigment molecules
☐
(D). Magnetism

Gold nanoparticles exhibit colors because their conduction electrons oscillate collectively when excited by light (surface plasmon resonance).

#38. Q38. Raman spectroscopy for NP characterization may help identify:

☐
(A). None
☐
(B). Molecular vibrations and bond information, sometimes enhanced by Surface-Enhanced Raman Scattering (SERS)
☐
(C). Only the size of the nanoparticles
☐
(D). Thermal properties exclusively

Raman spectroscopy provides insight into molecular bond vibrations and can be enhanced by nanoparticle surfaces (SERS).

#39. Q39. Biosensors using nanomaterials might exploit:

☐
(A). None
☐
(B). Enhanced signal detection due to high surface area and unique electronic properties of nanoparticles
☐
(C). Standard optical detection methods only
☐
(D). Reduced sensitivity

Nanomaterials can significantly improve biosensor sensitivity and specificity through signal amplification and novel transduction mechanisms.

#40. Q40. Cytotoxicity of nanoparticles often depends on:

☐
(A). None
☐
(B). Factors such as particle size, surface charge, shape, and their potential to generate reactive oxygen species (ROS)
☐
(C). Their ability to integrate into DNA
☐
(D). Universal biocompatibility

The toxicity of nanoparticles is influenced by various factors including size, shape, and surface properties, which affect their interaction with cells.

#41. Q41. In drug delivery, nanocarriers might incorporate:

☐
(A). None
☐
(B). Liposomes, polymeric nanoparticles, dendrimers, or micelles to encapsulate and transport drugs
☐
(C). Only metallic particles
☐
(D). Bulk drug crystals

Nanocarriers such as liposomes and polymeric nanoparticles can enhance drug delivery by protecting the drug and enabling targeted release.

#42. Q42. Targeted nano-delivery can be achieved by:

☐
(A). None
☐
(B). Attaching specific ligands such as antibodies or peptides to nanoparticle surfaces to bind to target cell receptors
☐
(C). Random mixing with drugs
☐
(D). Increasing particle size

Surface functionalization with targeting molecules allows nanoparticles to home in on specific tissues or cell types.

#43. Q43. In Ayurvedic pharmaceutics, green synthesis of nanoparticles might align with:

☐
(A). None
☐
(B). Utilizing herbal decoctions where plant phytochemicals reduce metal ions to form nanoparticles
☐
(C). Traditional high-temperature chemical processes
☐
(D). Exclusive use of mineral acids

Green synthesis leverages natural compounds in herbs to produce nanoparticles in an eco-friendly manner.

#44. Q44. Magnetic nanoparticles (e.g., Fe_3O_4) can be used for:

☐
(A). None
☐
(B). MRI contrast, hyperthermia therapy, and magnetically guided drug delivery
☐
(C). Only cosmetic applications

☐
(D). Limited industrial uses

Magnetic nanoparticles have multifunctional applications in biomedical imaging, targeted drug delivery, and hyperthermia treatments.

#45. Q45. The molecular basis of nano-formulations often includes understanding:

☐
(A). None
☐
(B). The self-assembly forces such as electrostatic, hydrophobic, and hydrogen bonding interactions that yield stable nanoscale structures
☐
(C). Solely the elemental composition
☐
(D). Only the core material properties

Nano-formulation stability depends on molecular interactions at the surface that facilitate self-assembly and target recognition.

#46. Q46. One challenge in green nanotechnology is:

☐
(A). None
☐
(B). Maintaining consistent nanoparticle size and yield due to variability in biological extracts
☐
(C). Achieving complete chemical purity
☐
(D). Over-regulation by governments

Variability in natural extracts can lead to inconsistent results in nanoparticle synthesis.

#47. Q47. Core–shell nanoparticles might be designed to:

☐
(A). None
☐
(B). Combine a functional core (e.g., magnetic or plasmonic) with a shell that enhances stability, biocompatibility, and targeting
☐
(C). Serve solely as drug reservoirs without any targeting
☐
(D). Be easily disassembled in vivo

Core–shell structures allow the integration of desired functionalities with controlled surface properties.

#48. Q48. Dynamic Light Scattering (DLS) is used for:

☐
(A). None
☐
(B). Determining the particle size distribution of nanoparticles in colloidal suspensions
☐
(C). Measuring thermal conductivity
☐
(D). Analyzing chemical composition

DLS measures the fluctuation in light scattering due to Brownian motion, providing size distribution data of nanoparticles.

#49. Q49. Biosynthesis of gold nanoparticles by microbes or plants typically requires:

☐
(A). None
☐
(B). A metallic salt (e.g., $HAuCl_4$) and bio-reducing agents (such as phytochemicals or enzymes) from the biological extract
☐
(C). High concentrations of toxic chemicals
☐
(D). Exclusive use of physical forces

Biosynthesis employs natural reducing agents in biological extracts to reduce metal ions and form gold nanoparticles.

#50. Q50. The “protein corona” phenomenon occurs when:

☐
(A). None
☐
(B). Proteins in biological fluids adsorb onto the surface of nanoparticles, altering their biological behavior
☐
(C). Nanoparticles dissolve completely in blood
☐
(D). The nanoparticle core is composed entirely of protein

When nanoparticles enter biological fluids, proteins adhere to their surfaces (forming a corona), which can influence biodistribution, targeting, and toxicity.

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