

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 mardana 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 pharmaceuticals:

- (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 "rasaśāstra" 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 pharmaceuticals, 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., Fe₃O₄) 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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