

Fundamentals of Nanotechnology

Science · Answer Key · 25 Questions

1. What is the range of dimensions typically associated with nanotechnology?

- A) 1 to 100 micrometers
- B) 1 to 100 nanometers**
- C) 100 to 1000 nanometers
- D) 0.1 to 1 nanometer

2. Which phenomenon explains why gold nanoparticles appear red or purple rather than yellow?

- A) Surface Plasmon Resonance**
- B) The Photoelectric Effect
- C) Quantum Tunneling
- D) Thermal Conductivity

3. What does the abbreviation 'AFM' stand for in the context of imaging nanoscale surfaces?

- A) Atomic Force Microscopy**
- B) Automated Field Mapping
- C) Atomic Frequency Measurement
- D) Advanced Filter Mechanism

4. Which carbon allotrope, discovered in 1985, consists of a hollow sphere of 60 carbon atoms?

- A) Graphene
- B) Fullerene (Buckminsterfullerene)**
- C) Carbon Nanotube
- D) Diamond

5. At the nanoscale, which force often becomes dominant, making objects stick together?

- A) Gravitational force
- B) Magnetic force
- C) Van der Waals forces**
- D) Centrifugal force

6. What is the primary material used to create carbon nanotubes?

- A) Silicon
- B) Graphene sheets rolled into cylinders**
- C) Gold atoms in a chain
- D) Titanium dioxide crystals

7. Which property of silver nanoparticles makes them useful in medical applications like wound dressings?

A) High reflectivity

B) Antimicrobial properties

C) Superconductivity

D) Radioactivity

8. Who is often credited with giving the first lecture on the potential of nanotechnology, titled 'There's Plenty of Room at the Bottom'?

A) Albert Einstein

B) Richard Feynman

C) Marie Curie

D) Nikola Tesla

9. What is the primary difference between a scanning tunneling microscope (STM) and an optical microscope?

A) STM uses electrons, optical uses light

B) STM uses lasers, optical uses magnets

C) STM works only in vacuums, optical only in water

D) There is no significant difference

10. What is the term for the ratio of surface area to volume as objects become smaller?

A) It remains constant

B) It decreases significantly

C) It increases significantly

D) It becomes zero

11. Which of the following is a naturally occurring example of nanotechnology found in nature?

A) A desert sand dune

B) The structure of a lotus leaf

C) A cloud formation

D) The bark of an oak tree

12. What is the primary purpose of a cleanroom in nanotechnology research?

A) To keep the equipment warm

B) To prevent microscopic dust from contaminating samples

C) To store hazardous chemicals

D) To provide high-speed internet access

13. Graphene is composed of a single layer of carbon atoms arranged in what geometric pattern?

- A) Hexagonal lattice**
- B) Cubic grid
- C) Tetrahedral structure
- D) Amorphous cloud

14. Which unit is equivalent to one billionth of a meter?

- A) Millimeter
- B) Micrometer
- C) Nanometer**
- D) Picometer

15. What is the primary function of a 'quantum dot' in modern television displays?

- A) To cool the screen
- B) To produce precise colors**
- C) To increase the screen weight
- D) To act as a remote control

16. Which of these describes the 'bottom-up' approach in nanotechnology?

- A) Carving materials out of a larger block
- B) Building structures atom by atom**
- C) Using extreme heat to melt materials
- D) Using biological organisms to mine ore

17. Why are nanomaterials often more chemically reactive than bulk materials?

- A) They have more atoms inside
- B) They have a higher percentage of atoms on the surface**
- C) They are made of toxic elements
- D) They absorb more light

18. What is the purpose of 'self-assembly' in nanotechnology?

- A) Disassembling broken machines
- B) Arranging components into ordered structures without external guidance**
- C) Cleaning the workspace
- D) Printing labels on electronics

19. What happens to the melting point of a substance when it is reduced to nanoparticles?

- A) It stays the same
- B) It typically increases
- C) It typically decreases**
- D) It becomes unstable

20. Titanium dioxide nanoparticles are commonly used in which consumer product for their UV-blocking ability?

- A) Food flavoring
- B) Sunscreen**
- C) Battery acid
- D) Plastic wrap

21. What is the main challenge in the mass production of carbon nanotubes?

- A) They are too heavy
- B) They are extremely expensive to produce in high quality**
- C) They melt at room temperature
- D) They cannot be seen by the human eye

22. In the context of nanotechnology, what is 'lithography' used for?

- A) Creating patterns on a substrate**
- B) Measuring atomic weight
- C) Refining gold ores
- D) Calculating chemical bonds

23. Which field combines biology and nanotechnology to develop medical treatments?

- A) Nanomedicine**
- B) Astrophysics
- C) Paleontology
- D) Botany

24. What effect does the wave-like behavior of electrons have at the nanoscale?

- A) Quantum confinement**
- B) Increased rust
- C) Thermal expansion
- D) Faster oxidation

25. Which of the following is a potential application of nanotechnology in water treatment?

A) Adding sugar to water

B) Using nanofilters to remove pollutants

C) Freezing the water

D) Evaporating the water