

1. Size of a red blood cell is in the order of

(a) 10^{-3} m (b) 10^{-4} m

(c) 10^{-6} m (d) 10^{-8} m

2. When a cube of 1m dimension is break into cubes of 1 nm dimension, how many cubes are produced?

(a) 10^{18} pieces (b) 10^{24} pieces

(c) 10^{27} pieces (d) 10^9 pieces

3. Quantum Dots are

(a) metals (b) semiconductors

(c) insulators (d) none of the above

4. Photolithography is a

(a) top-down technique (b) bottom-up technique

(c) sol-gel technique (d) exfoliation technique

5. The size of a DNA diameter is in the order of

(a) 10^{-9} m (b) 10^{-12} m

(c) 10^{-6} m (d) 10^{-4} m

6. Sputtering is a

(a) top-down technique (b) bottom-up technique

(c) sol-gel technique (d) exfoliation technique

7. Packing fraction of the simple cubic lattice of lattice parameter 'a'

(a) 0.524 (b) 0.424

(c) 0.568 (d) 1.221

8. Surface of a nanoparticle exhibits

(a) Van der Waals bond (b) dangling bonds

(c) Ionic bonds (d) covalent bonds

9. Decreasing the particle size

(a) Surface area decreases (b) surface area remain the same

(c) Surface area increases (d) none of the above

10. Driving force for sintering is

(a) lowering the surface energy (b) increasing the surface energy

(c) lowering the surface area (d) lowering the surface properties

11. Surface energy of nanomaterials can be decreases via

(a) Sintering (b) Agglomeration

(c) Oswald ripening (d) All the above

12. Nano sized polymers made out of branched units are called

a) Dendrimers b) Composites

c) Carbon-based materials d) Metal-based materials

13. Which property of nanoparticles provides a driving force for diffusion?

- a) Electrical Properties
- b) High surface area to volume ratio
- c) Thermal properties
- d) Sintering ability

14. Chemical Potential of a nanoparticle varies as a Function of

- (a) area of the particle
- (b) volume of the particle
- (c) Surface Curvature
- (d) All the above

15. Reducing size of a semiconductor nanoparticle, it becomes

- (a) Metal
- (b) insulator
- (c) Dielectric
- (d) piezoelectric

16. Application of Quantum dots is in

- (a) Electronics
- (b) Optoelectronics
- (c) Mechanics
- (d) mechatronics

17. Vesicle is well-known as

- a) Nanostructure
- b) Nanoparticle
- c) Nanocrystal
- d) Supramolecular system

18. Gold nanoparticles exhibits the color of

- (a) Violet
- (b) blue
- (c) Red
- (d) different color based on size

19. Nanoscience is the study of

- (a) Phenomenon on the scale of 1-100 nm
- (b) Phenomenon on the scale of single atoms
- (c) Phenomenon on the scale of electrons
- (d) All of the above
- (e) None of the above

20. Naturally Occurring nanomaterials

- (a) Volcanic Ashes
- (b) viruses
- (c) DNA
- (d) All the above

21. Reducing size of the nanoparticles increases

- (a) Thermal conductivity
- (b) reactivity
- (c) Transparency
- (d) luminescence

22. Reducing size of a semiconductor nanoparticles increases

- (a) Band gap
- (b) dielectric constant
- (c) Electrical conductivity
- (d) Career concentrations

23. Nanoparticles are susceptible of

- (a) Dispersion
- (b) sedimentations
- (c) Agglomerations
- (d) none of the above

24. 1 cm radius sphere is converted into same volume with 1 nm radius spheres, how much surface area increases?

(a) 10^6 times (b) 10^{17} times

(c) 10^9 times (d) 10^7 times

25. A particle having 2 nm diameter is known as

(a) Zero dimensional particle (b) one dimensional particle

(c) Two dimensional particle (d) three dimensional particle

26. To obtain stabilize dispersion of nanoparticles, people use

(a) Acid (b) salt

(c) Bases (d) Surfactants

27. Nanoscale materials are best known as of size & dimension

(a) Greater than 100 nm (b) Lesser than 100 nm

(c) Greater than 150 nm (d) Lesser than 150 nm

28. If bond length of a material is $\sim 2.84 \text{ \AA}$, then what is the diameter of the atom?

(a) 1.24 \AA (b) 1.14 \AA

(c) 1.42 \AA (d) 1.34 \AA

29. High surface energy in nanomaterials are due to the

(a) High surface charges (b) dangling bonds

(c) High surface area (d) All the above

30. Carbon nanotubes are known as

- (a) 1D nanomaterials
- (b) 2D nanomaterials
- (c) 3D nanomaterials
- (d) All the above

31. Morphology of 50 nm particles can be identified using

- (a) Scanning Electron microscopy
- (b) Transmission Electron microscopy
- (c) Optical microscopy
- (d) All the above

32. A CNT of 2 nm size can be visible using

- (a) Transmission Electron Microscopy
- (b) Scanning Electron microscopy
- (c) High Resolution Transmission Electron Microscopy
- (d) none of the above

33. A monolayer graphene is known as

- (a) Zero-dimensional material
- (b) one-dimensional material
- (c) Two-dimensional material
- (d) Three-dimensional material

34. Defects in monolayer graphene can be identified using

- (a) Transmission Electron Microscopy
- (b) Scanning Electron microscopy
- (c) High Resolution Transmission Electron Microscopy
- (d) none of the above

35. Three to four layers of graphene is known as

- (a) A few-layer graphene
- (b) bulk graphene
- (c) Multilayer graphene
- (d) all the above

36. Single-Walled CNTs are

- (a) Semiconducting (b) metallic
- (c) Both (a) &(b) (d) None of the above

37. Multiwalled CNTs are

- (a) Semiconducting (b) metallic
- (c) Dielectric (d) None of the above

38. Which of the material shows the Ballistic charge transport properties?

- (a) Zinc oxide nanowire (b) CdS quantum dots
- (c) Single-Walled CNTs (d) Multiwalled CNTs

39. The term Quantum Wire describes

- (a) A carrier confined in zero dimensions (b) a carrier confined in one dimensions
- (c) A carrier confined in two dimensions (d) a carrier confined in three dimensions

40. When the size of the quantum dots decreases

- (a) Band gap decreases (b) band gap increases
- (c) Band gap remains same (d) none of the above

41. An electron-hole pair in quantum dot known as

- (a) Polaritons (b) Phonons
- (c) Excitons (d) Boson

42. Light absorption properties of quantum dots changes with size due to

- (a) The change in carrier mobility
- (b) the change in conductivity
- (c) The change in charge carrier density
- (d) the change in bandgap

43. Single-electron transistors are made out of

- (a) Zero-dimensional nanomaterial
- (b) One-dimensional nanomaterial
- (c) Two-dimensional nanomaterial
- (d) All the above

44. The optoelectronic properties of a quantum dot particle changes as a function of

- (a) Electrical conductivity
- (b) Charge carrier mobility
- (c) Charge carrier density
- (d) Size and shape

45. The confinement is a quantum effect, which has profound effects on the

- (a) Conductivity
- (b) mobility
- (c) Quantum gravity
- (d) Density of states

46. A quantum dots of size 5 nm can be visualized using

- (a) HR-Transmission Electron microscopy
- (b) Scanning Tunneling Microscopy
- (c) Atomic force microscopy
- (d) All the above

47. In QD-solar cells, the QDs are used as a

- (a) Light absorber
- (b) light reflector
- (c) Light transmitter
- (d) none of the above

48. 'QD cytotoxicity' primarily refers to

- (a) Quality of QDs of being toxic to cells
- (b) Quality of QDs of being non-toxic to cells
- (c) Quality of QDs of being adhere to cells
- (d) Quality of QDs of being non-adhere to cells

49. 'Semiconductor quantum wells' are often used in

- (a) Optical modulator
- (b) laser-diode
- (c) Interconnects
- (d) solar cells

50. This light emission properties in semiconducting QDs occurred due to the effect from

- (a) Photoluminescence
- (b) phosphorescence
- (c) Photo excitations
- (d) All the above

51. Formation of metal quantum dots in glassy matrix via moderate temperature annealing is a good example of:

- (a) Heterogeneous nucleation
- (b) Homogeneous nucleation
- (c) Oswald ripening
- (d) grain reforming

52. Monolayer graphene exhibits very high

- (a) In-plane electrical conductivity
- (b) out-of-plane electrical conductivity
- (c) in-plane thermal conductivity
- (d) out-of-plane career mobility

53. Electrons can move ____ times faster than Silicon

- (a) 1000
- (b) 2000

(c) 100 (d) 200

54. Colloidal gold nanoparticles below 100 nm size show different colors due to the effect of:

- (a) Polariton vibration (b) Plasmon vibration
(c) Phonon vibration (d) Photon vibration

55. The mobility of electrons in graphene

- (a) 200,000 cm²/Vs (b) 1200,000 cm²/Vs
(c) 200,00 cm²/Vs (d) 2000,000 cm²/Vs

56. ZnO and TiO₂ nanoparticles show UV-absorption properties due to their

- (a) High Transparency (b) Wide bandgap
(c) High-reflectance coefficient (d) High absorptivity

57. In Chemical Vapor Deposition process graphene grows on copper due to

- (a) Catalytic Solid solution (b) Catalytic Segregation and precipitation
(c) Catalytic dissociation (d) Catalytic segregation

58. One-dimensional nanostructure grows because of the

- (a) Homogeneous growth process (b) symmetric growth process
(c) Asymmetric growth process (d) all of the above

59. Which are the physical vapor deposition processes?

- (a) Sputtering (b) e-beam evaporation

(c) Thermal evaporation (d) all the above

60. Nano-scale mechanical properties of a material is evaluated using

- (a) Nanoindentation (b) micro-hardness tester
(c) UTM (d) Scanning electron microscopy

61. Carbon nanotubes having concentric two walls, is known as

- (a) Single walled carbon nanotube (b) multi-walled carbon nanotube
(c) Double-walled carbon nanotube (d) a few-walled carbon nanotube

62. In ancient India, most of the ceramic vases were coated with color contain

- (a) Carbon nanotube (b) graphene
(c) Silicon nanoparticle (d) gold nanoparticle

63. Carbon fullerenes molecule with 60 carbon atoms are known as C_{60} with

- (a) Spherical symmetry (b) Rotational Symmetry
(c) Icosahedral symmetry (d) Translational Symmetry

64. Mesoporous materials exhibits the pore size ' d ' as:

- (a) $d < 1 \text{ nm}$ (b) $2 \text{ nm} < d < 50 \text{ nm}$
(c) $50 \text{ nm} < d < 150 \text{ nm}$ (d) $20 \text{ nm} < d < 100 \text{ nm}$

65. Zeolites are naturally occurring crystalline porous materials having pore size of

- (a) 0.3 nm to 1 nm (b) 1 nm to 3 nm

(c) 5 nm to 10 nm (d) 10 nm to 15 nm

66. The interlayer spacing of graphite is

(a) 0.34 nm (b) 0.64 nm

(c) 0.31 nm (d) 0.61 nm

67. Conformal coating can be done only by

(a) Sputtering (b) e-beam evaporation

(c) Chemical vapor deposition (d) Thermal evaporation

68. The maximum resolution of high resolution transmission electron microscope can be

(a) 10 nm-20 nm (b) 20 nm -30 nm

(c) 0.1 μm -1 μm (d) 0.1 nm-1 nm

69. The maximum resolution of Optical microscope can be

(a) 1000 nm (b) 200 nm

(c) 100 nm (d) 100 μm

70. Organic compounds such as liposomes, micelles and vesicles, are added to foods to encapsulate other substances such as vitamins or flavorings are known as

(a) nanotubes (b) nano micelles

(c) nano vesicles (d) nanocapsules

71. Which nanoparticles are used as UV filters in sun creams

- (a) NiO & CuO (b) Al₂O₃ & CeO₂
(c) ZnO & TiO₂ (d) MoO₃ & MoO₂

72. Scanning tunneling microscopy detects the

- (a) dielectric constant of a materials (b) surface conductivity
(c) magnetic properties (d) surface porosity

73. Nanoparticles are used for elimination of various pollutants due to their

- (a) High thermal conductivity (b) High electrical conductivity
(c) High porosity (d) High chemical reactivity

74. Nanomaterials are transformed into a lightweight, gel-like structure, are known as

- (a) Aerogel (b) sol-gel
(c) Nano-gelation compound (d) Aerosol

75. A gas sensor made out of nano-tin di-oxide uses which characteristics to detect the changes?

- (a) Dielectric constant (b) conductivity & resistivity
(c) Capacitance (d) specific permeability

76. CNT-based electrodes are used in batteries due to their

- (a) high conductivity (b) ballistic charge transport
(c) High surface area (d) high thermal expansion coefficient

77. How many oxygen atoms can fit in 1 nm

- (a) 10 (b) 7
(c) 12 (d) 14

78. In fullerene, one carbon atom is connected to how many nearby carbon atoms?

- (a) 2 (b) 3
(c) 4 (d) 5

79. with the decrease of the particle size, the melting temperature of a material

- (a) Remains the same (b) Increases
(c) Decreases (d) none of the above

80. NiO nano particles are well know

- (a) electrocatalyst (b) dielectric
(c) semiconducting (d) piezoelectric

81. In Dye sensitized solar cells, nano TiO_2 is used due to it

- (a) Transparency (b) semiconducting and transparency
(c) Semiconducting (d) Good light absorption properties

82. The term “nanotechnology” was used by

- (a) Albert Einstine (b) Richard P. Feynman
(c) Niels Bohr (d) Rutherford

83. Molecular inorganic magnetic materials possess individual molecules or molecular assemblages

(a) that contain p-metal atoms with paired electrons (b) that contain p-metal atoms with unpaired electrons

(c) that contain d-metal atoms with paired electrons (d) that contain d-metal atoms with unpaired electrons

84. Titanium di-oxide (TiO_2) is a white colored pigment as

(a) It absorbs all wavelengths in the UV and IR regions (b) It absorbs all wavelengths between 380 and 800 nm

(c) It reflects no wavelengths in the VIS region (d) It absorbs no wavelengths in the VIS region

85. Scientists are interested on the 'Chevrel' phases because of

(a) They are non-conducting (b) They are ferromagnetic

(c) They are superconducting (d) They are ferroelectric

86. Nano-scale surface roughness can be measured using

(a) Scanning electron microscopy (b) transmission electron microscopy

(c) Optical microscopy (d) Probe microscopy

87. Nano-scale magnetic materials are used for the applications in

(a) Electronics (b) optoelectronics

(c) Spintronics (d) Valleytronics

88. 'Dendrimers' are composed of synthetic or natural

- (a) Amino acid, nucleic acids, and carbohydrates (b) phosphoric acid, carboxylic acid and carbohydrates
- (c) Lactic acid, acetic acid, and formic acid (d) phosphoric acid, carboxylic acid and hydrochloric acid

89. Hydrogen bond is stronger than the

- (a) Metallic bond (b) ionic bond
- (c) Covalent bond (d) Van der-Walls bond

90. In nano-magnetic particles, coercivity increases as

- (a) Particle size decreases (b) particle size increases
- (c) Surface charge decreases (d) Surface charge increases

91. The CNTs with armchair structure shows _____ properties

- (a) Semiconducting (b) Insulating
- (c) Metallic (d) ferroelectric

92. Young modulus of CNT is _____ times than steel

- (a) 10 (b) 50
- (c) 100 (d) 200

93. MEMS devices shows

- (a) Electrical response to applied mechanical inputs (b) mechanical response to applied electrical inputs

- (c) Dielectric response to applied electrical inputs (d) magnetic response to applied electrical inputs

94. Micelles are small spherical, colloidal particles with size 1–100 nm, formed by

- (a) Colloidal suspension (b) self-assembling molecules
(c) Direct deposition of molecules (d) suspended biomolecules

95. The CNTs with zigzag edge shows _____ properties

- (a) Semiconducting (b) Insulating
(c) Metallic (d) ferroelectric

96. Decreasing particle size of a semiconductor crystal Fermi energy level will

- (a) Decrease (b) Increase
(c) Remains the same (d) first decrease then increase

97. With decreasing the particle size, the X-ray diffraction peaks will be

- (a) Broaden (b) Shrink
(c) Remain the same (d) shifted

98. A 'qubit' is

- (a) A basic unit of quantum dots (b) a basic unit of quantum mechanics
(c) A basic unit of quantum information (d) a basic unit of quantum technology

99. 'Coulomb blockade' effect is the

- (a) Decrease in electrical conductance at small bias voltages (b) Increase in electrical conductance at small bias voltages
- (c) Decrease in electrical resistance at small bias voltages (d) Increase in dielectric constant at small bias voltages

100. The fluorescence spectra of quantum dots (QDs) are red-shifted if

- (a) The size of QDs decreases (b) the size of QDs increases
- (c) The size of QDs remains the same (d) the absorption of QDs decreases

- | | |
|---------|---------|
| 1. (c) | 26. (d) |
| 2. (c) | 27. (b) |
| 3. (b) | 28. (c) |
| 4. (a) | 29. (d) |
| 5. (a) | 30. (a) |
| 6. (b) | 31. (b) |
| 7. (a) | 32. (c) |
| 8. (b) | 33. (c) |
| 9. (c) | 34. (c) |
| 10. (a) | 35. (a) |
| 11. (d) | 36. (c) |
| 12. (a) | 37. (b) |
| 13. (b) | 38. (c) |
| 14. (d) | 39. (c) |
| 15. (b) | 40. (b) |
| 16. (b) | 41. (c) |
| 17. (d) | 42. (d) |
| 18. (d) | 43. (a) |
| 19. (a) | 44. (d) |
| 20. (d) | 45. (d) |
| 21. (b) | 46. (d) |
| 22. (a) | 47. (a) |
| 23. (c) | 48. (a) |
| 24. (d) | 49. (b) |
| 25. (a) | 50. (a) |

- | | |
|---------|---------|
| 51. (b) | 76. (c) |
| 52. (a) | 77. (b) |
| 53. (c) | 78. (b) |
| 54. (b) | 79. (c) |
| 55. (a) | 80. (a) |
| 56. (b) | 81. (b) |
| 57. (b) | 82. (b) |
| 58. (c) | 83. (d) |
| 59. (d) | 84. (d) |
| 60. (a) | 85. (c) |
| 61. (c) | 86. (d) |
| 62. (d) | 87. (c) |
| 63. (c) | 88. (a) |
| 64. (b) | 89. (d) |
| 65. (a) | 90. (a) |
| 66. (a) | 91. (c) |
| 67. (c) | 92. (a) |
| 68. (d) | 93. (b) |
| 69. (b) | 94. (b) |
| 70. (d) | 95. (a) |
| 71. (c) | 96. (c) |
| 72. (b) | 97. (a) |
| 73. (d) | 98. (c) |
| 74. (a) | 99. (a) |
| 75. (b) | 100.(b) |

THE CANDIDATES ARE REQUESTED TO SEND THEIR OBJECTIONS IN THE ABOVE KEY (with proper justification) LATEST BY 14.12.2022 FIVE P.M AT key.object@aktu.ac.in