

## Quiz 1\_23: TOPICS IN NANOSCIENCES

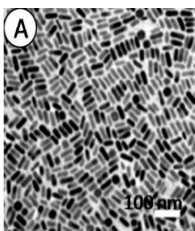
MAX. MARKS: 60

Write your Roll No.:

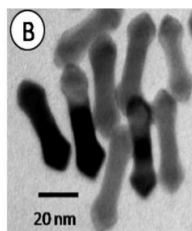
Note: Tie this question paper to your answer sheet.

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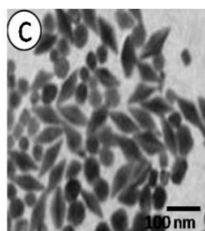
- 1 State whether the following statements are true or false: [2×5]
- (a) The melting temperature of metal nanoparticles decreases when their size increases.
  - (b) Glittering colors of peacock feather is the result of iridescence arising from a 2D photonic crystal comprising of an array of melanin rods, keratin matrix, and air holes.
  - (c) Buckyballs are actual molecules and not extended materials because they have a well-defined atomic structure and molecular weight.
  - (d) PbTe belongs to the plasmonic nanomaterials category.
  - (e) Nanocarbon graphene is not an extended material like fullerene.
- 2 Fill in the blanks with the correct words. [2×5]
- i Nanoscience is the field of science that **Measures** and **Explains** the changes of the properties of substances as a function of size at the nanoscale.
  - ii If **One** dimension(s) of the 3D nanostructure is/are quantum confined, then it is called a Quantum Well.
  - iii **.....based colors/paints can be eco-friendly, pigment-free colors/paints that would not fade and might appear more vibrant.**
  - iv The phenomenon, **Ostwald Ripening**, is ubiquitous in colloidal systems and has a primary role in determining their long-term stability.
  - v CA hysteresis on hydrophobic surfaces increases with increasing surface roughness in the low-roughness region but drastically **Decreases** when the roughness becomes large and the composite configuration, in which the liquid does not penetrate the asperities.
- 3 Write the conventional names used to identify the nanoparticles as shown in the following images (A, B, C, D, & E). [2×5]



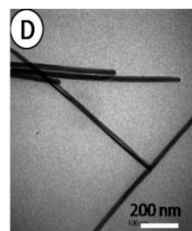
Nanorods



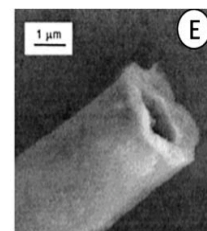
Nanoshuttle



Nanobipyramid



NanoWire



NanoTube

LSPR: localised surface plasmonic resonance : light impinging on the metal surface cause optical excitation of electron , such oscillation occur at the interface of surface known as surface plasmons. At certain frequency there is maximum there is resonance at which there is max absorption / scattering that occurs at surface known as surface plasmonic resonance, in nonmaterial this is localised to surface hence localised surface plasmonic resonance

Organic nano particles are naturally occurring vs inorganic are engineered , example dendrimers, dna ,liposomes, inorganic semiconductor ,metal

- 4 Define nanomaterials. Material with any external dimension in the nano scale( ranging from 1-100nm ) or having internal or surface structure at the nano scale. [3]
- 5 Mention two special properties of magnetic nanomaterials. [2]  
Coating of magnetic nano material with the organic substance such as lipid leads to better solubility.  
Contrast material in magnetic nuclear imaging.  
Super paramagnetism.
- 6 What is LSPR? Ability to generate giant magnetic resistance+ ability to control the spin : spintronic. [2]  
Act as media for storage.
- 7 Mention two major differences between organic and inorganic nanomaterials. [2]
- 8 What is an artificial atom? Why is it called so? [1+2]
- 9 Calculate Wenzel contact angle for a hydrophilic surface with roughness factor = 1.5 and Young's contact angle =  $74^\circ$ . Comment on the hydrophilicity/hydrophobicity of the surface. [5,1]  
 $\cos\theta$ , it becomes more hydrophilic
- 10 Calculate the Cassie-Baxter area fractions of the solid,  $f_s$ , of a square surface with a repeating pattern of square pillars of  $1\ \mu\text{m}$  width with a  $1\ \mu\text{m}$  spacing. What will be the value of  $f_s$  for a smooth surface? [5,1]
- 11 Deduce an expression for the chemical potentials' difference between a 5 nm radius particle and a sufficiently large macroscopic particle. Compare their chemical potentials. [4,2]

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