

This question paper contains 4 printed pages]

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S. No. of Question Paper : 5812

Unique Paper Code : 6792011203

Name of the Paper : Chemical Energetics, Ionic Equilibria and
Nanomaterials - DSC-5

Name of the Course : B.Sc. (H) Biological Sciences

Semester : II

Duration : 2 Hours

Maximum Marks : 60

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *four* questions in all.

Question No. 1 is compulsory.

All questions carry equal marks.

Use of non-programmable scientific calculator is permitted.

1. Attempt any *five* questions :

- (a) State the advantages of using Scanning Electron Microscopy. (SEM)
in the characterisation of nanomaterials.
- (b) Discuss the application of nanomaterials in drug delivery.

P.T.O.

- (c) Differentiate between bond dissociation energy and bond energy taking a suitable example.
- (d) Explain the ionic product of water. How does it vary with temperature.
- (e) Illustrate the *three* applications of solubility product principle.
- (f) How are nanomaterials different from their bulk materials ? 5×3
2. (a) What distinctions exist between the methods used to characterize nanoparticles using TEM and SEM techniques ? Which one, and why, is more suited for determining the size and shape of nanoparticles ?
- (b) A monobasic acid has a dissociation constant equal to 1.8×10^{-5} at 25°C. Calculate its degree of dissociation at a concentration of 0.2 M at the same temperature.
- (c) Draw Born-Haber cycle for LiCl system for calculating the lattice energy.
- (d) Define the following :
- (i) Enthalpy of formation
- (ii) Enthalpy of neutralization. 4,4,4,3
3. (a) What is buffer capacity ? Explain the buffer action of a basic buffer.
- (b) Calculate the solubility in grams per litre of $\text{Al}(\text{OH})_3$ in water at 25°C if $K_{sp} = 8.5 \times 10^{-32}$.

- (c) Describe carbon nanotubes and their applications with respect to biosensors.
- (d) What are Quantum dots (QD) ? Compare the band energies for a quantum dot nanocrystal and a bulk semiconductor. 4,4,4,3
4. (a) Which properties make nanomaterials suitable for catalytic applications ?
- (b) Explain the difference between the top-down and bottom-up approach for the fabrication of nanomaterials giving *one* example of each.
- (c) Describe how Infrared (IR) spectroscopy helps in characterizing the nanoparticles by giving an example.
- (d) The pH of pure water at 50°C is less than 7. Justify. 4,4,4,3
5. (a) Derive the relation between the pH of the solution and the relative amounts of the acid and salt present in it.
- (b) Explain in detail how XRD analysis is important in nanomaterial characterisation.
- (c) Describe in brief *one* method of synthesis of silver nanoparticles.
- (d) The heat of neutralization of a strong acid with a strong base is $-57.36 \text{ kJ mol}^{-1}$. If the heat of neutralization of a weak acid HA with a strong base be $-42.02 \text{ kJ mol}^{-1}$, then compute the heat of ionization of weak acid. 4,4,4,3

6. (a) Derive the following expressions for a salt of strong acid and weak base :

$$K_h = \frac{K_w}{K_b}$$

$$pH = \frac{1}{2}pK_w - \frac{1}{2}pK_b - \frac{1}{2}\log C.$$

- (b) Explain the effect of temperature on pH.

- (c) Write short notes on any *two* :

(i) Green method of synthesis of nanomaterials

(ii) Self-assembled nanostructures

(iii) Bioimaging.

4,3,4+4