

**INSTRUCTIONS:** Answer **all** questions

**Total time** = **60 minutes**

**Total marks** = **60**

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1. (25 marks)

- a) Explain, in as much detail as possible, why a colloid of charged nanoparticles is stable in the absence of added salt but aggregates when a sufficiently high concentration of salt is added.
- b) i) Explain the term **steric stabilization** of colloids.  
ii) What is the energetic basis of steric stabilization?  
iii) What are the advantages of steric stabilization over electrostatic stabilization?

2. (20 marks)

- a) Briefly explain the terms **top down** and **bottom up** in the context of nanofabrication.
- b) Describe the interactions involved in the formation of self-assembled monolayers of alkanethiols on gold surfaces.
- c) Briefly describe the technique of either dip pen nanolithography or nanoshaving using alkanethiols on gold surfaces.
- d) Describe a strategy for detection of specific sequences of single stranded DNA that relies on the use of gold nanoparticles.

3. (15 marks)

- a) What is **critical micelle concentration** (CMC)?
- b) How do the shapes of micelles change as the concentration of surfactant increases? Illustrate your answer with sketches.
- c) Explain how micelles of different sizes and shapes can be used as templates (tiny reaction vessels) for the preparation of nanomaterials of different sizes and shapes.