



**RAJARATA UNIVERSITY OF SRI LANKA  
FACULTY OF APPLIED SCIENCES**

**B.Sc. (Joint Major) Degree in Chemistry and Physics  
Fourth Year – Semester II Examination – July 2020**

**PHY 4211 –NANOMATERIALS AND NANOTECHNOLOGY**

**Time: Two (02) hours**

**Answer all questions.**

A non-programmable calculator is permitted.

All undefined symbols or terms appear below have their usual meanings.

1.
  - a) State five reasons why nanotechnology is important. (5 marks)
  - b) “Nanotechnology is new, but utilization of materials at nanoscale is not new”  
Write down two examples to confirm this statement. (6 marks)
  - c) What are the Feynman’s challenges in nanotechnology? (8 marks)
  - d) Explain the classification of nanomaterials with examples according to structural configuration and dimensions. (16 marks)
  - e) Briefly discuss the “top down” and “bottom up” approaches in nanotechnology with a suitable diagram. (15 marks)
2.
  - a) Relate specific structural and geometric characteristics of nanoporous polymers to their functions. (7 marks)
  - b) Briefly describe the three basic methods to design nanoporous polymers. (7 marks)
  - c) Discuss the following techniques.
    - i. Track etching
    - ii. Micellar imprinting
    - iii. Thermally induced phase separation (TIPS) (3×5 marks)
  - d) Biodegradable polymers play a key role in self-assembled diblock copolymer nanoporous polymer synthesis. Integrate your knowledge about polylactide (PLA) to defend the statement. (15 marks)
  - e) Synthesis of nanocomposites is one of the applications of nanoporous polymers. Describe the synthesis, and elaborate the advantages of nanocomposites. (6 marks)

3. Carbon nanotubes (CNTs) are allotropes of carbon. These cylindrical carbon molecules have interesting properties that make them potentially useful in many applications in nanotechnology, electronics, optics and other fields of materials science, as well as in architectural fields.

- a) List any three methods to produce carbon nanotubes. (9 marks)
- b) What are the three unique geometries of carbon nanotubes? (6 marks)
- c) Explain the formation of each geometry considering the chiral vector  $(n, m)$  of a nanotube (Note: The three different geometries of carbon nanotubes are also referred as flavors of carbon nanotubes). (10 marks)
- d) Sort the following CNTs into the three geometries mentioned in above (b)  
 $(5, 5)$ ,  $(0, 8)$ ,  $(4, 7)$ ,  $(9, 0)$ ,  $(1, 1)$  (5 marks)
- e) List five properties of carbon nanotubes. (5 marks)
- f) Why do C-60 molecules call as bucky balls? (5 marks)
- g) "The Young's modulus of the multiwall nanotubes (MWNT) is higher than that of single wall nanotubes (SWNT) and the Young's modulus of the SWNT is greater than that of "SWNT bundle". Justify the statement. (10 marks)

4.

- a) Lithium-ion batteries are the latest crest in the rechargeable battery technology.
  - i. Use a schematic diagram to describe the working mechanism of lithium ion battery. (8 marks)
  - ii. Polymer electrolytes are used in lithium-ion batteries. Name two types of polymer electrolytes and evaluate their advantages and disadvantages. (12 marks)
- b) Water pollution is a global issue. In north central province of Sri Lanka, this issue is critical.
  - i. Name major types of water pollutants. (5 marks)
  - ii. Nanoporous membranes show high performance in water purification. Elaborate three types of nanoporous polymer membranes in water purification. (15 marks)
- c) Reverse osmosis (RO) is widely used water purification technique locally. Distinguish the function of a RO filter from a Nanoporous membrane filter and compare the advantages and disadvantages of both techniques in water purification. (10 marks)

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