RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (Joint Major) Degree in Chemistry and Physics /
Bachelor of Science Honours Degree in Applied Sciences

Fourth Year - Semester II Examination – Jan / Feb 2023

PHY4211 – NANOMATERIALS AND NANOTECHNOLOGY

Time: Two (02) hours

Answer **all four** questions

Use of a non-programmable calculator is permitted.
All the symbols have their usual meaning.

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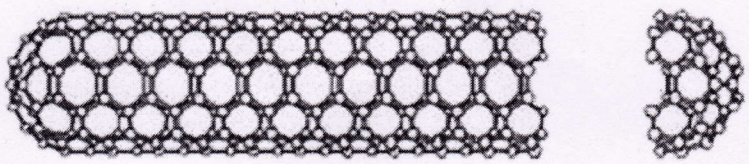
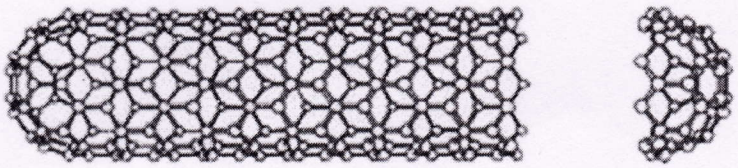
1. a) Name the following three types of nanotubes and discuss the electrical properties of each type.

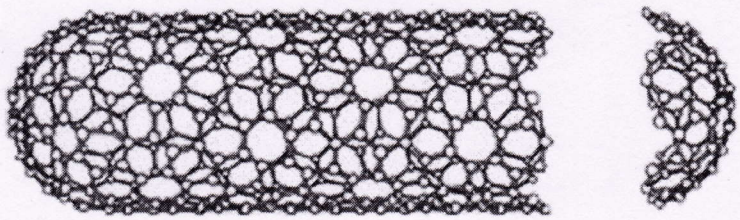
(a)



(b)



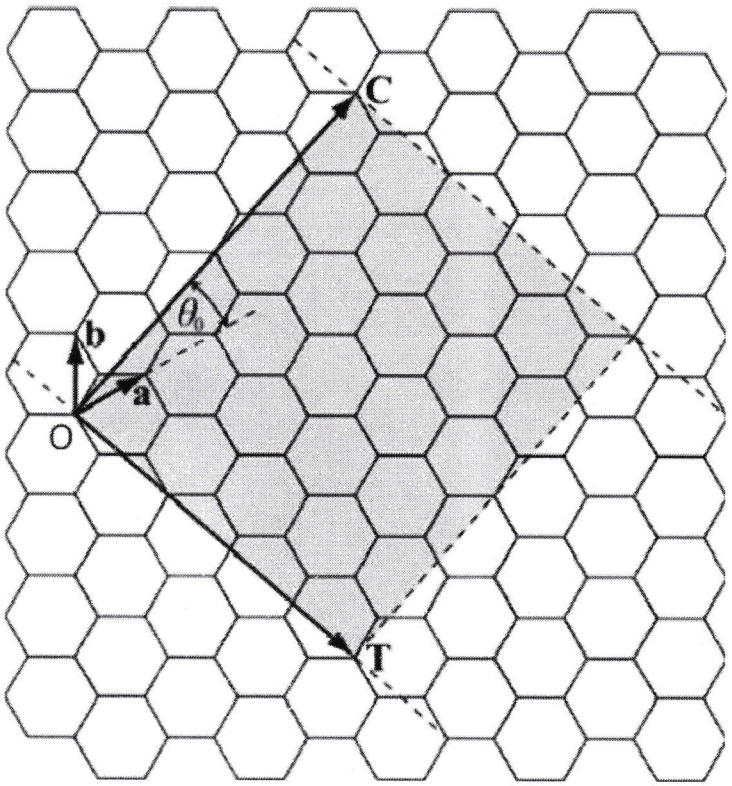
(c)



(09 Marks)

Contd.

b) The atomic arrangement of a graphene sheet is shown in the figure below.



i. Give the coordinates (n,m) of the chiral vector, if the CNT is formed by wrapping the sheet from O to C or from O to T. (04 Marks)

ii. Calculate the diameter of CNT for each wrapping. The C-C bond length is $1.41\,\overset{0}{A}$. What would be the wavelength of the emitted laser beam, if these tubes are used to make a laser? Assume the hopping parameter to be 3.5 eV (12 marks)

2. a) "The properties of materials can be different at the nanoscale for two main reasons". Briefly explain the statement. (08 marks)

b) "Nanotechnology is new, but utilization of materials at nanoscale is not new". Write down two examples to confirm this statement. (04 marks)

Contd.

c) What is it meant by "bottom-up" and "top-down" approach in nanotechnology ? Explain with a suitable diagram. (06 marks)

d) Show and justify with diagrams, how one could recognize metallic and semiconductor nanotubes in view of their density of states. (07 marks)

3. a) K^+ controlled graphene oxides are capable of filtering out some cations in water purification. Briefly explain the process giving relevant examples. (06 marks)

b) Self-assembled diblock copolymers are used in preparation of nanoporous polymers. Elaborate the role of biodegradable polymers in this method. (07 marks)

c) Among water pollutants, heavy metals play a significant role. Nanoporous membranes can be engineered to selectively capture such pollutants. Discus the synthesis and application of bio-inspired block copolymer nanoporous membrane in water purification. (06 marks)

d) Nanotechnology is a rapidly emerging field. Among the vast versatilities offered by the technology, some inherent negative impacts yet required immediate attention. Discuss. (06 marks)

4. a) Account for the nanoporous polymers emphasizing their tunability, applications, and structure and geometry. (08 marks)

b) Elaborate the track etching process. (05 marks)

c) Exemplify the synthesis of nanoporous polymer electrolytes. (06 marks)

d) Compare the micellar imprinting and molecular imprinting (06 marks)

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