

Instructions to candidates

Duration: One (01) hour

Number of questions: Two (02)

Number of questions to be answered: Two (02)

Mark allocation: 100

All symbols carry their usual meaning.

1. a. World witnessed major industrial revolutions in its recent history. What were these industrial revolutions that took place in the world?
(10 marks)
- b. What do you mean by nanoscience and nanotechnology? Extend your answer to describe these two terms in relation to minerals.
(10 marks)
- c. Describe the importance of one billionth of a meter or a 10^{-9} m when it comes to “developing new technologies”.
(05 marks)
- d. “Nanoscale materials show intrinsic properties”. Explain this with examples.
(05 marks)
- e. Nanomaterials can only be seen using specialized instruments and techniques. Outline five (05) techniques that can be used to “observe” nanoscale mineral samples.
(10 marks)
- f. Explain how an image is generated from a nanoscale mineral sample (e.g., nanographite) when a Scanning Electron Microscope (SEM) is used to observe it. X-rays are generally characteristic to the element from which they are originating. Describe how this can be used to identify elements in a composition of a mineral.
(10 marks)

(Total 50 marks)



2. a. What are the major crystalline forms of carbon?
- b. What do you mean by SWCNT, MWCNT, Graphene and Graphite Nanoplatelets?
- c. Discuss the major experimental techniques currently used to produce graphene. Which technique do you think is suitable for large scale production? Give reasons.
- d. What are the main crystallographic polymorphs of TiO_2 .
- e. Outline the steps in the large scale production processes of TiO_2 from its mineral ore.

(10x5 = 50 marks)