



## CETMPA3: PAPER 3

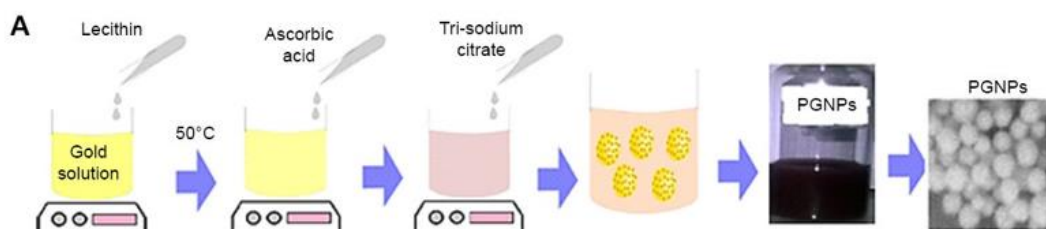
### SECTION A: GREEN CHEMISTRY

#### QUESTION 1

1.1 State and explain ANY FIVE of the twelve principles of green chemistry

and give examples where possible. (10)

1.2 Based on the information given in the schematic 1 below regarding the synthesis of green silver nanoparticles.



1.1.1 What are the four main advantages of using plants extracts for synthesising nanoparticles. (3)

1.1.2 Mention any six natural reducing agents found in plants and explain their role during the synthesis of silver nanoparticles. (5)

1.1.3 Propose characterisation methods that confirm the presence of gold nanoparticles. (6)

1.3 Since the discovery of nanoscience, the application of nanomaterials in nanotechnology has been published by many researchers. Most of the nanomaterials are applied in the treatment of water pollution. Differentiate the outcomes during the application of general pollution treatment methods and green chemistry. (4)

1.4 Briefly explain the principle on which the following sources of renewable energy work:

1.4.1 wind energy (4)

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- 1.4.2 river energy (4)
- 1.5 Explain the importance of recycling waste materials. (4)
- 1.6 Explain the difference between physical recycling and chemical recycling of PET water. (4)
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## **SECTION B: NANOMATERIALS CHEMISTRY**

### **QUESTION 2**

- 2.1 In synthesis of nanomaterials usually we have two approaches, state the two approaches and discuss the advantages and disadvantages thereof. (5)
- 2.2 Lebo synthesised  $\text{BiVO}_4$  nanoparticles to use them as a photocatalyst to treat water that contains organic pollutant like dyes.
- 2.2.1 Explain the principle of a photocatalyst (4)
- 2.2.2 How can one characterise the optical properties of  $\text{BiVO}_4$ ? (2)
- 2.3 Explain the use of the following techniques in nanomaterials characterisation
- 2.3.1 Zeta potential (2)
- 2.3.2 X-Ray Diffraction (XRD) (2)
- 2.3.3 Fourier transform infrared spectroscopy (FTIR) (2)
- 2.4 Studies have indicated that the properties of carbon based nanomaterials have lead to them being largely applied in various materials.
- 2.4.1 Mention types of carbon nanotubes (2)
- 2.4.2 List the properties of carbon nanotubes which makes them applicable. (3)
- 2.5 Silver nanoparticles are widely applied in enhancing the signal in electrochemical sensors. The nanoparticles are coated on the electrode's surface.
- 2.5.1 Propose the method that can be applied to determine the electrochemical conductivity of silver nanoparticles modified sensors. (4)
- 2.6 Nanomaterials have a wide range of applications. State three applications in each of the following areas:
- 2.6.1 Industry (3)
- 2.6.2 Water treatment (3)
- 2.6.3 Government (3)
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**SECTION C: WATER QUALITY****QUESTION 3**

- 3.1 Explain the following terms:
- 3.1.1 Degradation (2)
- 3.1.2 Photocatalysis (2)
- 3.1.3 Photosynthesis (2)
- 3.2 Explain the following terms and briefly describe how these parameters are measured.
- 3.2.1 Temperature (3)
- 3.2.2 Biological Oxygen Demand (3)
- 3.2.3 Heavy metals (3)
- 3.3 Briefly give outline the guidelines, policies and standards that are used in South Africa to provide good water quality according to *Water Services Act (WSA)* 108 of 1997. (5)
- 3.4 In University of Johannesburg laboratory, you are provided with acid mine drainage sample. Answer the following questions based on the sample composition.
- 3.4.1 Mention any three organic pollutants that are available in acid mine drainage. (3)
- 3.4.2 Describe their toxic effects (3)
- 3.4.3 Propose the detection and removal method for each of the pollutants. (5)
- 3.5 Discuss the tertiary water treatment method. (6)
- 3.6 In South Africa, the following types of water \_\_\_\_\_; \_\_\_\_\_; \_\_\_\_\_ and \_\_\_\_\_ are monitored to avoid environmental pollution. (3)

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