



UNIVERSITI
TEKNOLOGI
PETRONAS

FINAL EXAMINATION SEPTEMBER 2022 SEMESTER

COURSE : **AAB2012 - MATERIALS CHARACTERIZATION AND ANALYTICAL TECHNIQUE**
DATE : **8 DECEMBER 2022 (THURSDAY)**
TIME : **2.30 PM - 5.30 PM (3 HOURS)**

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

Note :

- i. There are **FIVE (5)** pages in this Question Booklet including the cover page .
- ii. **DOUBLE-SIDED** Question Booklet.

1. EFG Enterprise company provides various services of surface analysis to all materials based on microscope. A clear understanding of the surface characterization on any materials is very important for a material engineer.
 - a. Compare **FIVE (5)** advantages and **FIVE (5)** disadvantages between optical microscope and electron microscope usage.

[10 marks]
 - b. Identify **TWO (2)** reasons why some of the parts of your specimen seen in the microscope is not clear.

[4 marks]
 - c. Propose the solutions to overcome the problem in part (b).

[6 marks]
 - d. Suggest **TWO (2)** new features to make the microscope better in any potential application. Justify your answer.

[5 marks]

2. Atomic Force Microscopy (AFM) analysis has widely been applied in various field such as biochemistry, biophysics, and nanotechnology. Specifically, the equipment is for measuring, imaging, and manipulating materials down to the nanoscale.
- a. Classify **THREE (3)** AFM modes while characterizing the changes of nanoparticles and thickness surface layer of graphene-aluminium oxide composites. Illustrate and explain **THREE (3)** AFM modes in detail. [19 marks]
- b. Propose **THREE (3)** findings on how to reduce the error and noise in AFM tip and cantilever to obtain better results. Justify your answer. [6 marks]

3. Thermogravimetric analysis (TGA) technique is used to characterize the material decomposition based on the peak interpretation that related to the mass loss.

a. Describe in detail the best step by step procedure to prepare the sample for TGA.

[19 marks]

b. In designing a good qualitative identification of material components, the thermal stability of the material is one of the matters that is highly emphasized. Identify **TWO (2)** possible reasons why the mass residue increases from 0% to 10% at 500°C in the case of modified polymer material. Justify your answer.

[6 marks]

4. X-ray diffraction (XRD) is one of the equipment that can be used to characterize the structural information of a material, for instance, the crystallinity, bond angles and interatomic distance.

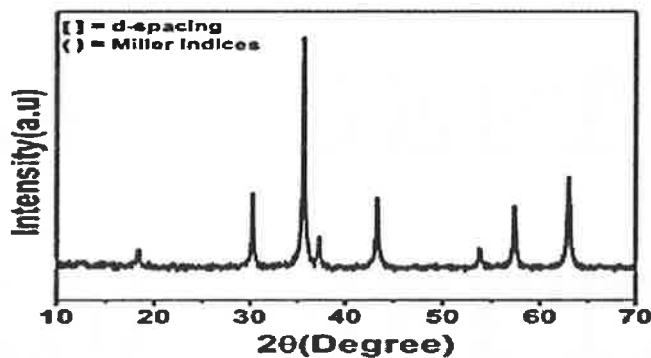


FIGURE Q1a

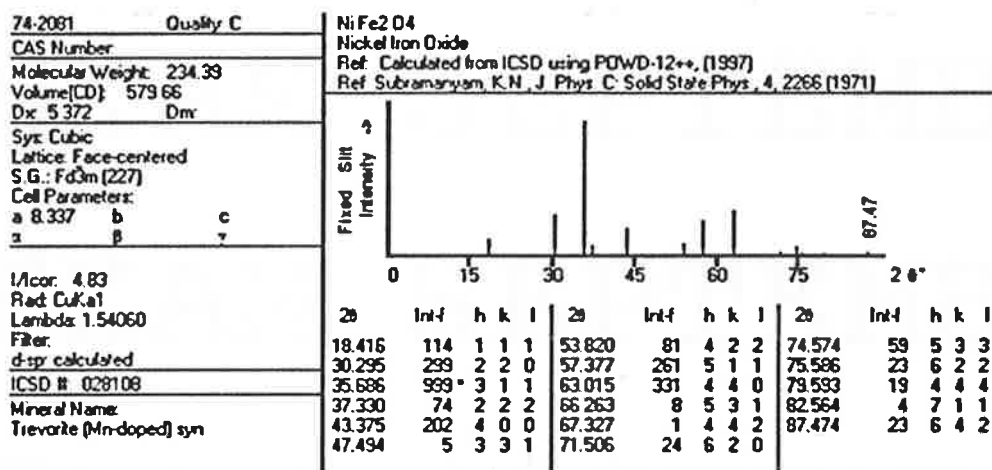


FIGURE Q1b

- a. Using any suitable diagram such as planes in unit cell, explain step by step procedure to identify an unknown material using Hanawalt (manual method).

[10 marks]

- b. Analyse the data peaks in FIGURE Q1a by correlate it with the JCPDS card in FIGURE Q1b file database.

[8 marks]

- c. Discuss how the textures analysis affect the diffraction. Use any possible material texture illustration. Justify your answer.

[7 marks]

- END OF PAPER -

