



FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY (BTAC 2021S and BTAC 2022S)

ACH 4406: FUEL CHEMISTRY AND TECHNOLOGY

END OF SEMESTER EXAMINATION

SERIES: JULY 2025

TIME: 2 HOURS

DATE: Pick Date Select Month Pick Year

Instructions to Candidates

You should have the following for this examination

*Answer Booklet, examination pass and student ID*This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other **TWO** questions.**Do not write on the question paper.**

Question ONE

a) Explain each of the following terms:

- i) Fuel
- ii) Fuel cell
- iii) Natural gas
- iv) Synthetic petrol
- v) Calorie

(1 mark each, total 5 marks)

b) Describe the composition and preparation of producer gas

(8 marks)

c) Calculate GCV and NCV of a fuel from the following data:

Mass of fuel, $W = 0.75\text{g}$, $W = 350\text{g}$, Mass of water, $w = 1150\text{g}$, $\% \text{H}_2 = 2.8$, $\Delta T = 3.02\text{ }^\circ\text{C}$.

(5 marks)

d) Using a suitable schematic diagram, describe the working of each of the following fuel cells:

- i) Phosphoric acid fuel cell (6 marks)
- ii) Molten carbonate fuel cell (6 marks)

Question TWO

- a) Explain the production of synthetic petrol by the Bergius process (10 marks)
- b) i) Define or explain liquefied petroleum gas (LPG) (2 marks)
- ii) State six characteristics of LPG (6 marks)
- iii) State two advantages of LPG (2 marks)

Question THREE

- a) Explain the proximate analysis of coal under the following headings:
 - i) Moisture content (4 marks)
 - ii) Volatile matter (4 marks)
 - iii) Ash content (4 marks)
 - iv) Fixed carbon (4 marks)
- b) Discuss two main environmental implications of coal as a source of fuel (4 marks)

Question FOUR

Explain the ultimate analysis of coal under the following headings:

- i) Carbon and hydrogen (6 marks)
- ii) Sulphur (6 marks)
- iii) Nitrogen (6 marks)
- iv) Oxygen (2 marks)

Question FIVE

- a) Discuss the components of fuel cells under the following headings:
 - i) Electrodes (4 marks)
 - ii) Electrolyte (4 marks)
 - iii) Catalyst (4 marks)
- b) Explain four disadvantages of fuel cells (8 marks)