



NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF CHEMISTRY
2025_1 EXAMINATION

COURSE CODE: CHM 424

CREDIT UNIT: 2

COURSE TITLE: Non-Aqueous Solvent Chemistry

TIME: 2 HRS

INSTRUCTION: Answer Question ONE (1) and any other Two (2) Questions

1a.(i) Define the term Trouton constant and state its significant in non-aqueous chemistry (4 marks)
1a.ii. State two major influences or effect of relative permittivity of a solvent on solution properties. (3 marks)

1b (i) Under what condition is the solvent leveling effect of ammonia better than that of water? Give reason for your answer (4 marks)

1b (ii). Among water, ammonia and DMSO solvents, which of them will be most suitable for studying strong acids and phosphine? Give reason for your answer (4 marks)

1b (iii) The range of acidity that can be studied in water lies approximately between the effective proton affinities of 1130 kJ/mol and 1188 kJ/mol which gives a difference of 58 kJ/mol. Comment on the expected behaviour of a solute in water having proton affinity outside this range. (4 marks)

1c.i. What role does solvent-solute interactions play in solution-phase chemistry? (5 marks)
1c.ii. Give one example of molecule in which each of the following interactions are applicable,
i. Charge dipole interaction ii. Dipole dipole interaction
iii. Dipole Induced dipole interaction (2 marks each)

2a. What is autoionization? Write equation for the autoionization reaction of methanol. (8 marks)
(b) Given that the equilibrium constant for the autoionization reaction of methanol is 2.0×10^{-17} . Which is the stronger acid? Hence calculate the standard free energy change associated with the autoionization reaction at 303 K. Is the reaction spontaneous or not? Give reasons for your answer. (12 marks)

3a. What are the general characteristics of polar protic and aprotic solvent. (6 marks)
3b. Differentiate between ionizable and non ionizable solvents. (2 marks)
3c. Give reasons for the following solvent property of liquid ammonia. (4 marks)
i. liquid ammonia exhibits greater ionic mobility.
ii. Liquid ammonia is difficult for handling.
iii. Liquid ammonia is expected to be a poor solvent for polar substances compared to water.
iv. Hydrogen bond is weaker in liquid ammonia than in water.
(c) Under what condition can the HF solvent act as a base or acid during chemical reactions with HClO_4 . Write equations to support your answer. (4 marks)

(d) What is the limitation in using HF as a solvent and of what advantage is its solvent property? (4 marks)

4. a Write an equation to shows that liquid N_2O_4 exist as an equilibrium of a dimer and comment on the equation. (7 marks)
(b) Comment on the magnetic property of N_2O_4 as a guide for analytical purpose (6 marks)
(c) Provide reason for suitability of spectrophotometric instrumentation for studying N_2O_4 (4 marks)
(d) Why is liquid N_2O_4 considered a poor solvent for ionic substances. (3 marks)

5a. What are the special properties of liquid SO_2 (5 marks)
5b. Write (one for each) suitable equation to support the following properties of liquid SO_2
i. Neutralization reaction ii. Precipitation reaction
iii. Amphoteric reaction iv. Sulphonation reaction v. Solvolysis (3 marks each)