NATIONAL OPEN UNIVERSITY OF NIGERIA
UNIVERSITY VILLAGE, PLOT 91 CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESS WAY,
JABI - ABUJA.
FACULTY OF SCIENCES
DEPARTMENT OF CHEMISTRY
2024_2 EXAMINATION

COURSE CODE: **CHM424**
COURSE TITLE: **NON AQUEOUS SOLVENT**
COURSE UNIT: **2**
TIME: **2 HOURS**
INSTRUCTION: **Answer question one and any other two questions.**

QUESTION ONE

(1a) The relative permittivities of four solvents (A, B, C and D) were found to be 30, 14, 45 and 40 respectively, indicate which of the solvents that will be polar or non-polar? (3 marks)

(b) State two major effects of the relative permittivity of a solvent on solution properties. (4 marks)

(c) With suitable examples, differentiate between aprotic and protic solvents (3 marks)

(di)With a given reaction, define aLux-Flood acid-base concept (6 marks)

(ii) Indicate which of these solvents; water, ammonia and dimethyl sulphoxide(DMSO) will be most suitable for studying strong acids and phosphine? Give a strong reason for your answer (4 marks)

(ei)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.(5 marks)

(ii) Given that the equilibrium constant for the autoionization reaction of methanol is 2×10^{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. (5 marks)

QUESTION TWO

(2a). What is the significance of liquid ammonia, $NH_3(l)$, being an ionizing solvent like water? (3 marks)

(b). What is the difference between basic or photophilic solvents and amphiprotic solvents.? (4 marks)

(c). What is the difference between ionizable and non-ionizable solvents (4 marks)

(d). What is the difference between coordinating and non-coordinating solvents solvents (4 marks)

(d). What are inert solvents? (5 marks)

QUESTION THREE

(3a) Write an equation to show enthalpy change due to solvation and indicate when it is exothermic and endothermic (6 marks)

(b) Solvent-solute interaction is very significant in determining the possibility of solute dissolution, explain. (4 marks)

(c)With equations show the difference between interaction potential and Colombia potential of two charges (4 marks)

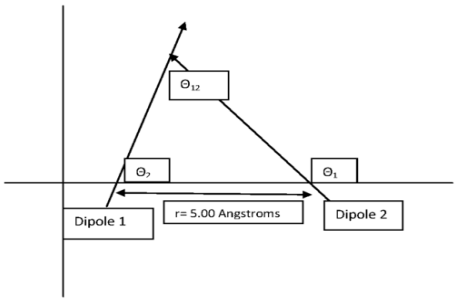
(d)Outline three factors that can affect the strength of a dipole-dipole interaction. (3 marks)

(e) Mention three factors that can influence two polar atoms when they interact with each other. (3 marks)

QUESTION FOUR

(4a) Calculate the potential energy of the dipole-dipole interaction between two HF molecules oriented along the x-axis in an XY coordinate plane whose area of positive charge is separated by 7.00 Angstroms from the area of negative charge of the adjacent molecule (The Dipole moment of the HF molecules, μ=1.92 D). Assume the molecules exist in a vacuum such that ϵ_0=8. 8541876×10−12C2N−1m−2.If the orientation of HF given above coincided with the under-listed, calculate the potential energy. (6 marks)

(b)What happens when a molecule with a permanent bond dipole comes close to one with no bond dipole (2 marks)



(c)What is polarizability? (2 marks)

(d) Describe London dispersion force (4 marks)

(e)Write and balance an equation for the reaction of nitrosyl chloridewith antimony pentachloride, sulphuric acid and silver thiocyanate (6 marks)

QUESTION FIVE

(5a) Write suitable equations showing three reactions of NOCl with various forms of silver Phosphate (6 marks)

(b) Enumerate six propertiesof phosphoryl chloride (6 marks)

(c) Show self-ionization ofphosphoryl chloride (2 marks)

(d) Triethylamine dissolves in phosphoryl chloride to give a conducting solution. Show the behaviour equilibrium. (3 marks)

(e) Write suitable equation for the underlisted reaction for the formation of adduct POCl with $FeCl_3$

(3 marks)