



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE & APPLIED SCIENCES
2020_2 EXAMINATION...

COURSE: CHM 424- NON AQUEOUS SOLVENTS TIME ALLOWED: 2 HOURS
INSTRUCTION: ANSWER QUESTION ONE (1) AND ANY OTHER THREE (3)

QUESTION 1

- (a)(i) State the three types of liquid that can be used as solvent **(2 marks)**
- (ii) Which of the three types of solvents listed above is most widely used. Give examples **(2 marks)**
- (iii) State the best class of solvent that are suitable for low and high temperature experiments respectively **(2 marks)**
- (b)(i) State three reasons why water would be preferred as a solvent for systems that are soluble in water **(4 marks)**
- (ii) State two limitation against the use of water as a solvent **(2 marks)**
- (iii) What are the classes of solvent based on the presence of carbon in their structures **(2 marks)**
- (iv) With at least an example each, state the three major classes of organic solvents **(5 marks)**
- (v) Explain the basis for the classification of solvents based on polarity **(3 marks)**
- (vi) What are the solvent properties that makes water an excellent solvent **(3 marks)**

QUESTION 2

- a(i) State four desirable properties of a good solvent **(4 marks)**
- (ii) Explain why water is a better solvent for ionic compounds than SO_2 and liquid NH_3 **(1 marks)**
- (b) Define the term Trouton constant and state its significant in non-aqueous chemistry **(3 marks)**
- (c) Explain the relationship between Trouton's constant and heat of vapourisation of a solvent. **(4 marks)**

- (d) Based on the numerical value of Trouton's constant of a solvent, what are the characteristics of solvents that qualify them as structured and non-structured solvents **(3 marks)**

QUESTION 3

- (a) The ionization of water (aqueous solvent) and ammonia (nonaqueous solvent) leads to the following equations,

$$K_w = [H_3O^+][OH^-] = 10^{-14}$$

$$K_{am} = [NH_4^+][NH_2^-] = 10^{-33}$$

Calculate the neutral pH range for water and ammonia. **(4 marks)**

- (b) State the concept of leveling effect. Write at least four suitable equations (two for bases and two for acids to support your statement. **(6 marks)**
- (c) With suitable examples, differentiate between protic and aprotic solvents **(3 marks)**
- (d) State the solvent-system concept for acid and base **(2 mark)**

QUESTION 4

- (a). Barbitol is a sedative with molecular weight = 184.19 g/mole and is a weak monoprotic acid whose K_a equals 3.7×10^{-8} at 25°C. Calculate the pH of the solution containing 0.77 g of barbitol in 100.00 ml of water at 25 °C. **(7 marks)**

- (b)(i) What is autoionization, and, write an equation for autoionization of methanol **(2 marks)**

- (ii) Given that the equilibrium constant for the autoionization reaction of methanol is 2×10^{17} , is methanol a stronger acid than water (1×10^{14})? 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. **(6 marks)**

QUESTION 5

- (a)(i) Compare the features of amphiprotic solvents with that of water (use suitable examples to support your answer) **(3 marks)**
- (ii) State two characteristics of protonic solvents and give two examples **(3 marks)**
- (iii) State three characteristics/properties of aprotic/non-protonic solvents **(3 marks)**
- (iii) What is coordination and non coordinating solvents **(2 marks)**
- (b) State two characteristics of polar protic solvent **(2 marks)**
- (c) Differentiate between ionizable and non ionizable solvents **(2 marks)**