e) Which electromagnetic waves have the shortest wavelengths and highest frequencies? (1 mark)

f) One of the electron transitions in a hydrogen atom produces infrared light with a wavelength of 746.4 nm. What amount of energy causes this transition? (4 marks)

QUESTION THREE

a) Define the following terms;

i. Acid dissociation constant, (2 marks)

ii. Lewis acid, (2 marks)

b) Using a relevant equation, show auto ionization of water. (2 marks)

c) A solution of 0.050 M acetic acid and 0.035 M NaOH is prepared. What is the pH? (4 marks)

d) What mass of $Ba(OH)_2$(171.34 g/mole) is required to prepare 150 mL of a solution with a pH of 13.50? (4 marks)

e) Hypochlorous acid, HOCl, has a pKa of 7.52. What is the pH of 0.25 M solution of HOCl? What is the percent ionization? (4 marks)

f) Arrange the following acids in order of increasing acid strength. Explain your answer; HI, HF, HBr, H_2S. (2 marks)

QUESTION FOUR

a) In Quantum mechanics, quantum numbers are needed to characterize completely each electron in an atom. List and describe any three quantum numbers. (6 marks)

b) Write the quantum numbers that represent the following electrons: (2 marks)

i. $3s^2$

ii. $4f^6$

c) Which of the following are allowable sets of quantum numbers for an orbital? Explain. (6 marks)

i. n = 4, l = 4, ml = 0

ii. n = 3, l = 2, ml = 1

iii. n = 5, l = 3, ml = -4