



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

DIPLOMA IN BUILDING AND CIVIL ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING

SCU 102: CHEMISTRY

DATE: 31/5/2017

TIME: 2 Hours

INSTRUCTIONS

Answer questions one and any other two.

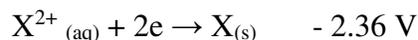
USE: Atomic numbers for: H=1, N=7, Ca=20, Sc=21, K=19, S=16

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) (i) Define the term pH (1 mark)
- (ii) Calculate the pH of 0.01 M H_2X acid. (2 marks)
- b) (i) Give an example each of a weak acid and a strong acid and write equations to show how they dissociate in water.
- (ii) Using s p d f orbital, write down the electronic configuration of an atom Y with atomic number 15. (5 marks)

- c) (i) Define an acid using Bronsted-Lowry theory.
(ii) Write an appropriate equation to show how HCO_3^- can act as Bronsted-Lowry base. (4 marks)
- d) Show how the hybridization of atomic orbital occurs in Methane molecule, CH_4 and name type of hybridization. (5 marks)
- e) Using dots and crosses draw the electronic structures for Ammonia molecule NH_3 and Ethane C_2H_6 . (5 marks)
- f) Explain why Calcium and Scandium are in different blocks of the periodic table. (4 marks)
- g) Calculate the value of a cell from the standard electrode potentials given below and write an overall equation for the cell.



SECTION B: ANSWER ANY OTHER TWO QUESTIONS

QUESTION TWO (20MARKS)

- a) Explain what is meant by hydrogen bonding. Show how hydrogen bonding is formed in a water molecule. (3 marks)
- b) Using dots and crosses draw diagrams to show electronic structures of:
- (i) K_2S
- (ii) CaCl_2
- (iii) C_2H_4 (8 marks)

- c) The atomic nuclei of atoms A and B contain:
- A- 40 neutrons, 20 protons
- B- 8 neutrons, 8 protons
- (i) State with reasons the Group and Period to which A and B belong.
- (ii) Using s p d f orbital write the electronic configuration of A and B.
- (iii) Draw the electronic structure formed when A combines with B. (9 marks)

QUESTION THREE (20 MARKS)

- a) The dissociation constant for a weak monobasic acid is $5 \times 10^{-8} \text{ mol dm}^{-3}$. Calculate the pH of the acid if its concentration is 10^{-2} M . (4 marks)
- b) (i) Define an acid using the Arrhenius and Bronsted-Lowry theories.
- (ii) State two advantages under the Arrhenius theory. (4 marks)
- c) Show by writing an appropriate equation how HSO_4^{-1} can act as Bronsted-Lowry acid and Arrhenius acid. (4 marks)
- d) State the basicity of the following acids and calculate their pH values.
- 0.1 M H_2SO_4
- $10^{-2} \text{ M H}_3\text{PO}_4$ (8 marks)

QUESTION FOUR (20 MARKS)

- a) Three elements A,B and C have atomic numbers 9, 20 and 16 respectively. Draw using dots and crosses the structures formed between: (i) A and B (ii) A and C. Name the types of bonds formed. (8 marks)
- b) Define dative (coordinate) bond.
- Show how the dative bond is formed when Ammonia combines with Hydrogen ion.
- Name the substance formed. (6 marks)
- c) Q is an element with electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6$.
- (i) Write down the atomic number of Q.
- (ii) State with reasons whether Q is a metal or a non metal.
- (iii) Name the block to which Q belongs. Explain. (6 marks)

QUESTION FIVE (30 MARKS)

- a) Explain the following terms.
- b) (i) Cathode
(ii) Electrolyte (6 marks)
- c) (i) Draw a diagram for an electrochemical cell using C and D metals (not actual symbols) given that their standard reduction potentials are -2.36 V and -0.44 V respectively. (5 marks)
(ii) Write ionic equations for the reactions in each half cell given that the valency for both metals is two. (4 marks)
(iii) Write down the overall cell equation. (2 marks)
(iv) Calculate the emf of the cell (3 marks)