



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 MECHANICAL ENGINEERING

DIPLOMA IN CIVIL ENGINEERING

SUPPLEMENTARY EXAMINATION

SCU 102: CHEMISTRY

DATE: 31/8/2017

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

Answer questions one and any other two.

USE: Atomic numbers for: H=1, N=7, O=8, C=6, Al=13, Cl=17, Na=11

SECTION A

QUESTION ONE (30 MARKS)

- a) Calculate the pH of 0.2 M H₂SO₄ acid. (3 marks)
- b) i) Give the conjugate acid of H₂O
ii) Differentiate between a weak acid and a strong acid.
iii) Using s p d f orbitals write down the electronic configuration of Potassium atomic number 19. (5 marks)
- c) i) Define an acid using Arrhenius theory.
ii) Write an appropriate equation to show how HSO₄⁻ can act as Arrhenius acid. (4 marks)
- d) Show how the hybridization of atomic orbitals occurs in Methane molecule, CH₄ and name type of hybridization. (5 marks)
- e) Using dots and crosses draw the electronic structures for water H₂O and methyl radical CH₃. (5 marks)
- f) State the group, period and the block to which element Q atomic number 21 belongs. (4 marks)
- g) Calculate the value of a cell from the standard electrode potentials given below.
$$\text{Mg}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Mg}_{(\text{s})} \quad - 2.36 \text{ V}$$
$$\text{Cu}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Cu}_{(\text{s})} \quad + 0.34 \text{ V}$$
 (4 marks)

SECTION B

QUESTION TWO (20MARKS)

- a) Explain what is meant by hydrogen bonding and give an example. (3 marks)
- b) Using dots and crosses draw diagrams to show electronic structures of:
i. AlCl₃
ii. Na₂O
iii. C₂H₂ (8 marks)
- c) The atomic nuclei of atoms P and Q contain:
P- 14 neutrons, 12 protons
Q- 7 neutrons, 7 protons
i. Draw the structure of the hydride of P.
ii. Using s p d f orbitals write the electronic configuration of P and Q. (9 marks)

QUESTION THREE (20 MARKS)

- a) The dissociation constant for a weak monobasic acid is $3.2 \times 10^{-8} \text{ mol dm}^{-3}$. Calculate the pH of the acid if its concentration is $1.25 \times 10^{-2} \text{ M}$. (4 marks)
- b) i) Define a base 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 HCO_3^{-1} can act as Bronsted-Lowry acid and Arrhenius acid. (4 marks)
- d) State the basicity of the following acids and calculate their pH.
0.2 M H_2SO_4
 10^{-2} M HCl (8 marks)

QUESTION FOUR (20 MARKS)

- a) Three elements A, B and C have atomic numbers 17, 12 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 Phosphorous trichloride combines with oxygen. Name the molecule formed. (6 marks)
- c) Q is an element with electronic configuration $1s^2 2s^2 2p^4$.
i. Write down the atomic number of Q.
ii. State with reasons whether Q is a metal or a non metal.
iii. Show how Q will combine with four chlorine atoms. (6 marks)

QUESTION FIVE (30 MARKS)

- a) Explain the following terms.
i. Anode
ii. Molten electrolyte (6 marks)
- b) i Draw a diagram for electrochemical cell using magnesium and iron given that the standard reduction potentials for magnesium and iron are -236 V and -0.44 V respectively. (5 marks)
ii Write ionic equations for the reactions in each half cell (4 marks)
iii Write down the overall cell equation. (2 marks)
iv Calculate the emf of the cell (3 marks)