



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BSCE, BTCE, BSEE, BTEE, BSME, BTME, BTMA, BTMD AND BSMD

: ACH 4130 : CHEMISTRY 1

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: SEPTEMBER 2018

TIME: 2HOURS

DATE: Sep 2018

Instructions to Candidates

You should have the following for this examination

Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Some useful information

Speed of light $c = 2.9979 \times 10^8 \text{ ms}^{-1}$

Plank's Constant $h = 6.6261 \times 10^{-34} \text{ J s}$

Avogadro's Constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ $1 \text{ nm} = 1 \times 10^{-9} \text{ m}$, Rydberg constant, $R = 109677.8 \text{ cm}^{-1}$

Question ONE

- a) Explain the following terminologies used in chemistry:
- Electronegativity (1 mark)
 - Atomic orbital (1 mark)
 - Electron affinity (1 mark)
- b) State Heisenberg uncertainty principle (2 marks)
- c) Which of the following set of quantum numbers are unacceptable? Explain your answers (4 marks)
- (1, 0, $\frac{1}{2}$, $-\frac{1}{2}$)
 - (3, 0, 0, $+\frac{1}{2}$)
 - (2, 2, 1, $+\frac{1}{2}$)
 - (3, 2, 1, $-\frac{1}{2}$)

- d) Give the values of the magnetic quantum numbers associated with the following orbitals:
- $3s$ (1 marks)
 - $4f$ (1 marks)
- e) Briefly describe the failures of Bohr's atomic model (3 marks)
- f) Elements X and Y have atomic numbers 37 and 52 respectively;
- Write the electronic configuration of X and Y (4 marks)
 - Use the configuration to identify the group and period of X and Y in the modern periodic table (4 marks)
 - Which of the two atoms X and Y has a larger atomic radius (1 mark)
- g) Determine the pH values for each of the following solutions?
- $10^{-3} \text{ mol dm}^{-3} \text{ HCl}$ (2 marks)
 - $1.0 \text{ mol dm}^{-3} \text{ HCl}$ (2 marks)
- h) What is the pH of 1.0 mol dm^{-3} of benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$), given that $K_a(\text{C}_6\text{H}_5\text{COOH}) = 6.4 \times 10^{-5} \text{ mol dm}^{-3}$ (3 marks)

Question TWO

- a)
- State plank's quantum theory (2 marks)
 - A red light has a wavelength of about 750 nm, calculate:
 - The frequency of the red light (2 marks)
 - The energy in Joules of a single photon associated with this frequency (2 marks)
- b) Give the symbol and properties of the following quantum numbers:
- Principal quantum number (2 marks)
 - Magnetic quantum number (1 mark)
 - Spin quantum number (1 mark)
 - Orbital angular quantum number (1 mark)
- c) What is the wavelength of light emitted when the hydrogen atom undergoes a transition from energy level $n = 5$ to level $n = 2$? (4 marks)
- d) The energy possessed by the electrons in atoms is quantized.
- What do you understand by the statement in d above? (2 marks)
 - Explain why atoms give line rather than continuous spectra (3 marks)

Question THREE

- a) Draw the Lewis structures of the following molecules. (The atomic numbers of N, O, F and Br are 7, 8, 9 and 35 respectively)
- NO_2 (3 marks)
 - BrF_3 (3 marks)
 - OF_2 (3 marks)
 - CH_4 (3 marks)
- b) Give the molecular geometry of the Lewis structure 3a(i) – 3a(iv) (4 marks)
- c) State the hybridization on the central atom in the structures 3a(i) – 3a(iv) (4 marks)

Question FOUR

- a) Define the following terms:
 i) Reducing agent (2 mark)
 ii) Oxidizing agent (2 mark)
- b) The equation below represents a redox reaction.



Identify:

- i) Reducing agent (1 mark)
 ii) Oxidizing agent (1 mark)
- c) Write a balanced half-reactions of the following chemical reactions taking place in acidic solution (4 marks)



- d) What is the oxidation numbers of the **underlined** elements in the following compounds?

- (i) Cr₂O₃ (1 marks)
 (ii) K₂Cr₂O₇ (1 marks)
 (iii) Mn₂O₇ (1 mark)
 (iv) SO₃²⁻ (1 marks)

- e) Would you use an oxidizing agent or reducing agent in order for the following reactions to occur? (2 marks)

- (i) $\text{ClO}_3^- \rightarrow \text{ClO}_2$
 (ii) $\text{Zn} \rightarrow \text{ZnCl}_2$

- f) Balance the following redox reactions (4 marks)



Question FIVE

- a) Define radioactivity (2 marks)
 b) List any two properties of
 i) α -particles (2 marks)
 ii) β - particles (2 marks)
 iii) γ - rays (2 marks)
 c) Briefly explain how the following decays occur in nuclear reactions
 iv) α – decay (2 marks)
 v) β – decay (2 marks)
 d) Half-life of radioactive element is 30 days. Calculate the time required for its activity to drop from 4800 counts to 300 counts per minute (ignore background counts) (4 marks)
 e) Complete the following equations (4 marks)



