



MACHAKOS UNIVERSITY

UNIVERSITY EXAMINATIONS 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATIONS 2018/2019

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN TELECOMMUNICATIONS (

SCH 200: ATOMIC STRUCTURE AND BONDING

DATE: 23/7/2019

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

ANSWER YOUR QUESTIONS IN ANSWER BOOKLET PROVIDED.

ANSWER QUESTION ONE [**COMPULSORY**] AND ANY OTHER TWO QUESTIONS.

USEFUL CONSTANTS:

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ Fm}^{-1}$$

$$N_0 = 6.023 \times 10^{23} \text{ mol}^{-1}$$

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

$$h = \text{Planck's constant} = 6.626 \times 10^{-34} \text{ J.s}$$

$$m = \text{mass of electron} = 9.1079 \times 10^{-31} \text{ kg}$$

$$e = \text{electronic charge} = 1.602 \times 10^{-19} \text{ C}$$

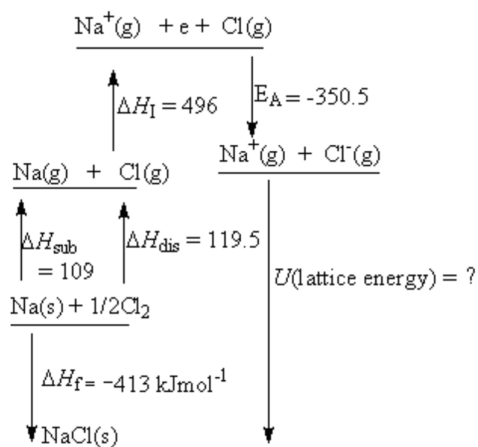
$$R = 109677.8 \text{ cm}^{-1}.$$

QUESTION ONE (THIRTY MARKS)

- a) Calculate the permitted energies of an electron confined in a box 1 Å wide. 4 marks
- b) Write Lewis structures of the following compounds:
- a) BaO; b) Aluminium oxide c) CH₄ 6 marks
- c) Draw the resonance structure benzene 2 marks
- d) Predict the hybridization of the central atom of a CH₄ molecule. 4 marks
- e) Define all terms in this equation. 4 marks

$$U = -\frac{N_o A z^+ z^- e^2}{4\pi\epsilon_o r_o} \left(1 - \frac{1}{n}\right)$$

- f) The following fire shows a Born-Haber cycle for the formation of NaCl. Calculate the lattice energy of formation 3 marks



- g) Write down the formula used to calculate Bond Order in molecules 3 marks

QUESTION TWO (TWENTY MARKS)

- a) What do you understand by Valence Bond Theory? 5 marks
- b) Using relevant examples describe Sp³, Sp² and Sp hybridization in methane, ethene and acetylene, respectively 15 marks

QUESTION THREE (TWENTY MARKS)

- a) Discuss the applications of the Radial distribution function $4\pi r^2 R(r)$ and the Radial wavefunction $R(r)$ in describing atomic properties 10 marks
- b) Describe the Bohr Model of the Atom (1913) and derive the equation radius of each orbit in Bohr's model given by;

$$r = \frac{n^2 h^2 \epsilon_o}{\pi m e^2}$$

10 marks

QUESTION FOUR (TWENTY MARKS)

Describe the periodic trends of the following atomic parameters 20 marks

1. Effective nuclear charge,
2. Atomic radii,
3. First ionization energies,
4. Electronegativity

QUESTION FIVE (TWENTY MARKS)

- a) Express the Linear Combination of Atomic Orbitals (LCAO) theory equation and describe in detail the rules and procedure used to construct molecular orbitals 10 marks
- b) Draw orbital correlation diagrams for hypothetical H-H and He-He molecules 10 marks