UNIVERSITY EXAMINATIONS 2017/2018

DIGITAL SCHOOL OF VIRTUAL AND OPEN LEARNING
SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SCH 200: ATOMIC STRUCTURE AND CHEMICAL BONDING

DATE: Monday 18th June 2018 **TIME: 11.00a.m-1.00p.m**

INSTRUCTIONS:

Answer ALL questions

Important data you may require

Planck's constant, $h = 6.626 \times 10^{-34}$ Js
Rydberg Constant, $R_H = 109677.58\ cm^{-1}$
Mass of electron, $m_e = 9.1094 \times 10^{-31}$ kg
Speed of light in a vacuum, c, is 3.00×10^{8}

a) Briefly expound on the following phenomena and briefly explain what their finding imply about the structure of atoms
   i. Photoelectric effect (6 marks)
   ii. Black body radiation (6 marks)
   iii. Zeeman effect (4 marks)

b) Briefly explain the following
   i. Dual nature of matter (3 marks)
   ii. Heisenberg uncertainty principle (3 marks)

c) The work function for metallic cesium is 3.43×10^{-19} J. Calculate the kinetic energy and the speed of the electrons ejected from a cesium metal surface by light of 300 nm wavelength.
   (4 marks)

d) Calculate the uncertainty in the position of a baseball of mass 100 grams traveling at a velocity of 40.2 m/s if the uncertainty in velocity is 1.2%. (4 marks)

Question two [20 marks]

a. Explain the following terms

i. Polar bond (2 marks)

ii. π-bond (2 marks)

iii. non-bonding orbital (2 marks)

a) Draw the molecular orbital energy level diagram of peroxide anion, O_2^{2-} (4 marks)

b) Use your energy level diagram in (b) above to answer the following questions:

i). Work out the bond order of peroxide and superoxide anions, O_2^{2-} and O_2^- respectively (4 marks)

ii). State which of the two anions above is paramagnetic and give a reason for your choice (3 marks)

iii). State which of the two anions above has a longer bond length and a reason for your choice (3 marks)

Question three [20 marks]

a) Distinguish between lattice energy and energy of atomization (4 marks)

b) Which of the compounds between $MgCl_2$ and $NaCl$ is likely to have higher lattice energy? Give reasons (4 marks)

c) Use simple chemical equation to represent transformation that accompany the following energy changes (4marks)

i. Enthalpy of atomization of aluminum
ii. Enthalpy of dissociation of Cl_2
iii. 3rd ionization energy of Al
iv. 2nd electron affinity of S

d) Use the data below to draw the Born Haber cycle for MgO and calculate its lattice energy

1st Ionization energy of Mg	+738kJ mol^{-1}
2nd Ionization energy of Mg	+1451 kJ mol^{-1}
1st electron affinity of O	-141 kJ mol^{-1}
2nd electron affinity of O	+744 kJ mol^{-1}
enthalpy of formation of MgO	-601 kJ mol^{-1}
enthalpy of atomization of Mg	+148 kJ mol^{-1}
Bond dissociation of O_2	+498 kJ mol^{-1}

(8 marks)