

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
100 Level First Semester Examination – Sep/Oct 2015
SCT 131-2 General Chemistry



Number of questions: Four (04) questions.

Answer all questions

Time allocation: Two (02) hours

Mark allocation: 200 marks



Universal gas constant, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

Plank's constant, $h = 6.626 \times 10^{-34} \text{ m}^2 \text{ kg s}^{-1}$

Rydberg constant, $R_H = 1.096 \times 10^7 \text{ m}^{-1}$

Electron mass = $9.1095 \times 10^{-28} \text{ g}$

Proton mass = $1.67252 \times 10^{-24} \text{ g}$

Neutron mass = $1.67495 \times 10^{-24} \text{ g}$

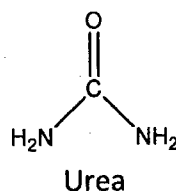
Velocity of light, $c = 2.998 \times 10^{-34} \text{ m s}^{-1}$

Avogadro constant, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

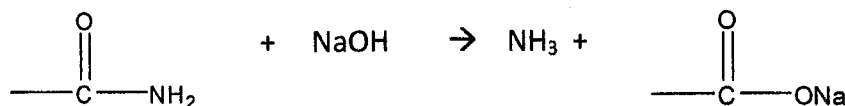
01. i. State the Bohr model for a hydrogen atom. What type of atoms or ions the Bohr model applies for? State two drawbacks of the model. (10 marks)
- ii. In 1985 Balmer showed that the wave number ($\bar{\nu}$) of any spectral line in the visible spectrum of atomic hydrogen could be given by a simple empirical formula. State the formula Identifying all terms therein. (05 marks)
- iii. Find the transition corresponds to the spectral line at 486 nm in the Balmer series? (20 marks)
- iv. Why do corresponding lines in the atomic spectra of hydrogen and deuterium appear at slightly different wavelengths? (05 marks)
- v. **Predict** the shape of the following molecules using VSEPR theory (15 marks)
 - a. PCl_5
 - b. I_3^-
 - c. SO_4^{2-}
- vi.
 - a. **State** two wave properties of electrons.
 - b. **State** Paulie's exclusion principle.
 - c. **Write** the four possible quantum numbers to represent an electron on 4d orbital.
 - d. **Draw** the shapes of s, p, d orbitals.

(15 marks)

02. Chemistry laboratory of Uva Wellassa University received a fertilizer sample to determine the urea quantity.



A first year student, Kamal was assigned for this task. He found that amides react with NaOH giving ammonia:



Based on that he followed the procedure given bellow

A urea sample (10.00 g) was taken into a flask and 3 M NaOH (100 ml) was added. Then it was boiled until no more ammonia evolves. Next the content was cooled and volume up to 100 ml. This solution was labled as "**Solution A**".

He had the plan to find remaining amount of NaOH in **Solution A** by, a titration against 0.05 M HCl solution and using that to calculate urea quantity in the fertilizer sample.

- i. Write the balance chemical equations for the following;
 - a. Reaction between NaOH and urea
 - b. Reaction between NaOH and HCl

(10 marks)

Table 1: the volume of 0.05 M HCl used to titrate **Solution A** (25.00 ml)

Trial	Initial burette reading /ml(± 0.05)	Final burette reading /ml(± 0.05)
1	0.00	20.15
2	21.00	41.05
3	22.00	42.05

- ii. Find the total amount of NaOH remain in the **Solution A** (100 ml) (12 marks)
- iii. Find the amount of urea in present in 10.00 g of fertilizer sample. (H=1, C=12, N=14, O=16, Na=23, Cl=35.5) (13 marks)
- iv. Find the W/W% of urea in the fertilizer sample (05 marks)

03. i a. State the octet rule.
 b. BH_3 is an electron deficient compound. Briefly explain how BH_3 attain octet. (15 marks)
- ii. a. Name two allotropic forms of C. write three general properties for each form. Draw the structure in each case.
 b. One of the allotropic forms of C conducts electricity. Name the allotropic form and briefly explain how it conducts electricity (15 marks)
- iii. Bond energies of the group 17 diatomic molecules are given bellow. Explain the variation of bond energies down the group.

Diatomic gas	F_2	Cl_2	Br_2	I_2
Bond energy / kJ mol^{-1}	126	210	158	118

- (10 marks)
- iv. H_2O is a liquid all the others hydrides of Group 16 are gases. Briefly explain the reason. (10 marks)
04. i. Usually metals have high melting and boiling points, but the melting points of group 1 and 2 elements are relatively low. Briefly explain the observation. (10 marks)
- ii. Be readily forms covalent compounds, but, other group 2 elements forms ionic compounds. (10 marks)
- iii. Why are Group 2 elements smaller than their Group 1 elements counterparts? (10 marks)
- iv. Why are Group 2 metals harder and have higher melting points than Group 1 metals (10 marks)

