

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF NATURAL SCIENCES

Mid Semester Examination  
Course No.: Chem 4241  
Course Title: Chemistry

Summer Semester: A. Y. 2022-2023  
Time: 1.5 hours  
Full Marks: 75

There are 3 (three) questions answer all of them. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

- 1 a) Describe how the Bohr's postulates can be used to calculate the radius of orbit of a hydrogen-like atom. 7 (CO1, PO1)
- b) "Within any period, values of first ionization energy tend to increase with atomic number, except for small drops at the group IIIA and VIA elements." Justify the statement with appropriate examples. 8 (CO2, PO2)
- c) Illustrate the energy level diagram valid for  $\text{Li}^{2+}$  ion. Compute the wavelength in Å of the line in Balmer series that is associated with drop of the electron from the third orbit. Given, Rydberg constant =  $1.097 \times 10^7 \text{ m}^{-1}$ . 10 (CO3, PO2)
- 2 a) Explain the significance of four different quantum numbers to describe an electron in atom? By using these four quantum numbers calculate the maximum number of electrons allowed into the fourth shell. 7 (CO1, PO1)
- b) "The Born-Haber Cycle can be used to derive the Lattice Energy of an ionic solid." Explain. 8 (CO2, PO2)
- c) 0.530 g of  $\text{C}_2\text{H}_5\text{OH}(l)$  is burnt to raise the temperature of a copper made beaker containing 200 g water. The temperature rises from 18.5 to 35.5 °C. Mass of the beaker is 150 g and specific heat for copper and water are 0.385 and  $4.18 \text{ Jg}^{-1}\text{C}^{-1}$ , respectively. Calculate enthalpy change of combustion citing at least three reasons that might contribute to the inaccuracy of the results. 10 (CO3, PO2)
- 3 a) Explain the principle for determination of order of a reaction,  $\text{A} \rightarrow \text{P}$  by differential method. 7 (CO1, PO1)
- b) "First-order reaction never complete." Justify this statement by considering a reaction,  $\text{A} \rightarrow \text{P}$ . 8 (CO2, PO2)
- c) 75 % of a reactant is consumed in a first-order reaction by 320 s. Compute the rate constant, k. Establish a relation between k and the half-life of this reaction mathematically and show the significance of the relationship graphically. 10 (CO3, PO2)