M.Sc. 3rd Semester Examination, 2021

CHEMISTRY

Course Title: Advanced General Chemistry

Course Code: CHEM 305 EID

Course ID: 31455

Time: 2 Hours **Full Marks: 40**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as possible

1. Answer *any five* of the following questions: 2×5 = 10

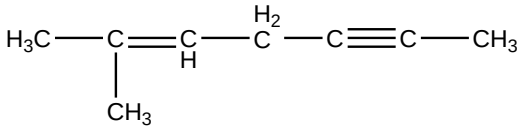
(a) Write down the full expression of the Kinetic equation of the gas and define each parameter.

(b) Calculate the average speed of oxygen molecules at 300 K temperature.

(c) Calculate the de Broglie wavelength of a car of mass 1000 kg and velocity 36 km/hr.

(d) Write down the maximum number of electrons that can be accommodated in a sublevel for which $l = 3$

(e) What is the hybridization of each of the carbon atoms in the following compound?



(f) Define ylides with example.

(g) What is nonclassical carbocation?

2. Answer *any four* of the following questions: 5×4 = 20

(a) Derive the expression for the average speed for the gas molecules from kinetic theory of gases. 5

(b) (i) Write down the expression for the fraction of molecules having velocity c to c+1 from Maxwell's kinetic theory and explain each parameter.

(ii) Arrange in increasing order: most probable velocity, root means square velocity and average velocity. Explain the order. 3+2 = 5

(c) (i) What is the diagonal relationship? Give one example.

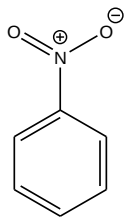
(ii) Calculate radius of the second Bohr orbit for hydrogen atom. (Planck's constant, $h = 6.262\times10^{-34}$ Js: Mass of electron = 9.1091×10^{-31} kg; Charge of electron e = 1.60210×10^{-19} C). 3+2 = 5

(d) Define electron affinity and ionization energy. How do they vary in the periodic table?

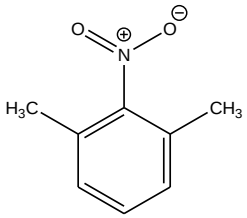
2+3 = 5

(e) (i) Draw orbital picture of acetylene (HC≡CH). Mention the hybridization and bond angle.

(ii) Explain why C-N bond length of compound (A) is shorter than C-N bond length of compound (B)?



A



B

3+2 = 5

(f) Define free radical. Give two pathways to synthesize free radical? 1+2+2 = 5

3. Answer *any one* of the following questions: 10×1 = 10

(a) (i) Derive the expression of fraction of molecules having kinetic energy ≥ ε_1 according to the Maxwell's kinetic theory.

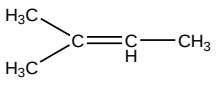
(ii) What is the shielding constant experienced by a 3d electron in the bromine atom?

(iii) Indicate the elements which belong to the same group from their atomic numbers as 9, 17, 24, 30, 35, 45.

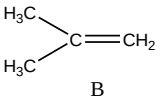
(iv) Why yellow precipitates observe in anoxic ground water when pumped from a deep well?

5+2+2+1 = 10

(b) (i) Which of the following alkene is more stable and why?



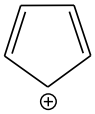
A



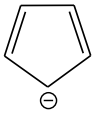
B

(ii) Which compound is aromatic among the three. Explain

Cyclopentadiene



Cyclopentadienyl cation



Cyclopentadienyl anion

(iii) Give an example of triplet carbene. Draw the structure of product formed by the reaction of singlet carbene with *cis*-butadiene. Explain whether the reaction is stereospecific or not.

2+3+(1+2+2) = 10