FIRST B. SC. EXAMINATION, 2019

(1st Year, 1st Semester, Old Syllabus)

CHEMISTRY (HONOURS)

PAPER - I

Time : Two hours   Full Marks : 50

Use a separate Answer script for each Group

GROUP - A

1. Answer *any two* questions :   5×2

    a) Find the units (**in SI system**) with reasons -

    i)   'B' and 'C' in $Z = 1 + \dfrac{B}{V_m} + \dfrac{C}{V_m^2}$

    ii) 'A' & 'B' in $C_{P,m} = R + \dfrac{A}{T} + BT^2$.

    iii) 'E_a' in $k = Ae^{-E_a/RT}$.

    b) Write down Maxwell-Boltzmann speed distribution equation with symbolic meanings. Draw its representative plots at two different temperatures and mention any two differences and one similarity.

    c) Estimate '$C_{V,m}$', '$C_{P,m}$' and 'γ' of sulfur dioxide gas, assuming its ideal behavior, using the *'Principle of Equipartition of Energy'*.

[Turn over

2. Answer **any two** questions : $3\frac{1}{2}\times 2$

   a) Draw the Maxwell-Boltzmann one-dimensional velocity distribution curves at two different temperatures and explain.

   b) Consider an ideal gas at constant pressure. What would be the effect of temperature on the value of its *mean free path* ? Give reasons.

   c) At a particular state, a gas contains 10^{15} molecules L^{-1} and the mean free path of the molecule is $\dfrac{1}{\sqrt{2}\pi}$ m. Calculate the diameter of the hard sphere molecule in pm.

5. Mention Bohr's postulates. Derive the energy of an electron in the nth orbit of H atom. $1\frac{1}{2}+2$

6. Using the energy expression of the electron in nth Bohr orbit of H-atom, the energy expression after Sommerfeld and making certain assumptions evaluate values for the semi major and semi minor axes of a Sommerfeld orbit. $3\frac{1}{2}$

7. With proper mathematical expressions discuss the creation of magnetic quantum number. What are the selection rules that govern electronic transitions as a consequence of it. $2+1\frac{1}{2}$

8. Write the mathematical expression for Moseley's law. Show with appropriate approximations why it is said to be the first experimental evidenc in favour of Niels Bohr's theory of the structure of an atom. $1+2\frac{1}{2}$

f) What will be the effect of adding a small amount of KI towards the rate of the reaction between CH_3CH_2Cl and aq. NaOH ? Rationalize your answer.   2

g) What do you mean by pKa value of a base and how can it be correlated with the strength of the organic base ?   1+1

GROUP - C

Answer question no. *4* and ***any two*** other questions.

4. a) What would be the wavelength of the 2nd line in the Paschen series in the emission spectra of H and He^+.

[Given $R_\infty = 109677$ cm^{-1}]   2

b) Find the total number of allowed spectral lines when an electron of H-atom jumps from the state $n = 4$ to the state $n = 2$. $1\frac{1}{2}$

c) Write the expression for wave-particle duality and use it to show that quantization of angular momentum as was proposed by Niels Bohr was correct. $1+1\frac{1}{2}$

d) Calculate the uncertainty in position of a particle if the mass of the particle is 0.099 kg and uncertainty in velocity $5\cdot27 \times 10^{-24}$ m/sec. [Given $h = 6\cdot625 \times 10^{-34}$ J.sec] $1\frac{1}{2}$

e) What is the de-Broglie wavelength associated with a H electron in the 3rd orbit. $1\frac{1}{2}$
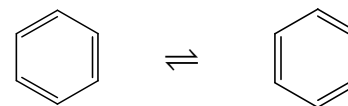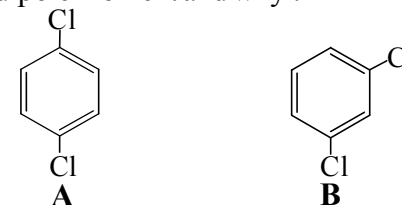
GROUP - B

3. a) Which of the following cations is more stable and why ?

$$CH_3 - CH_2 - \overset{\oplus}{C}H_2 \; ; \; CH_2 = CH - \overset{\oplus}{C}H_2$$ 2
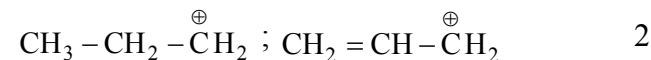
b) State with reason whether the following expression is correct or not.   2

c) Which one of the following molecules (**A** and **B**) will have higher dipole moment and why ?   2

d) Which one of the following compounds (**C** and **D**) will be less acidic and why ?   3

e) Show the order of base strength of n-BuNH$_2$, N-Bu$_2$NH and n-Bu$_3$N in water as well as in chlorobenzene and comment with reason whether they are same or different.   4