4. Attempt question (a) and give answer of ***any four*** from rest of the following questions : 4+(3×4)

a) Write electronic configuration of the following elements.

(i) Cr (ii) Cu (iii) Sc (iv) V 4

b) Calculate the de Broglie wavelength of a bullet ($m = 2\times10^{-3}$ kg) moving with a speed of 300 ms^{-1}. 3

c) What is the minimum uncertainty in the velocity determination of an electron if we want to locate it within 0·01 Å of the 1st Bohr radius in a hydrogen atom ? 3

d) The normal Ionization Potential (I.P) of hydrogen atom is $21{\cdot}79 \times 10^{-19}$ J. What will be the value of the I.P. when electron is raised to the 2s level ? 3

e) Find out the possible term symbols (L-S Scheme) for carbon atom. 3

f) Calculate the exchange energy (in terms of K) for three p-electrons when (i) Hund's rule is obeyed (ii) maximum pairing occurs. 3

Ex/1Ch/1S/3/19(Old)

FIRST B. SC. EXAMINATION, 2019

(1st Semester, Old Syllabus)

CHEMISTRY (SUBSIDIARY)

PAPER - IS

Time : Two hours Full Marks : 50

Use a separate answerscript for each group.

GROUP - A

1. a) State two experimental evidences from which we can conclude that at moderate temperature and pressure no gases behave ideally. 3

b) Indicate the Kinetic theory postulates that must be modified to explain the behavior of real gas. 2

c) What do you mean by mean and root mean square velocity for a gas molecule ? 2

d) Using the relation $PV = \frac{1}{3}mn\overline{c^2}$, prove that for an ideal gas the mean kinetic energy for a molecule is directly proportional to its absolute temperature. 2

e) What do you mean by critical temperature, pressure and volume of a gas ? 3

f) Near critical temperature, a gas does not follow the van-der Waals' gas equation - Explain or criticize. 2

g) For carbon dioxide $T_c = 300K$ and its critical density is 0.45 gm/c.c. Calculate van der Waals constants 'a' and 'b'. 3

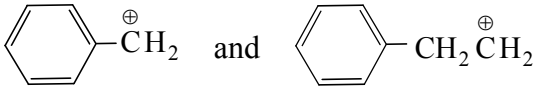
GROUP - B

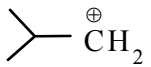
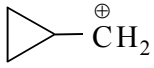
2. a) Draw the energy profile diagram of S_N1 and S_N2 type reactions and mention the starting material, intermediate, and product with proper example. 3

b) Explain the inertness of α -halocarbonyl compounds (R CO CH_2X) towards S_N1 reaction. 3

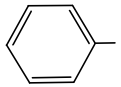
c) Comment on the relative stabilities of the following pairs of carbocations (answer ***any two***). 2×2

i) $\overset{\oplus}{C}(CH_3)_3$ and $\overset{\oplus}{C}H(CH_3)_2$

ii)  and

iii)  and 

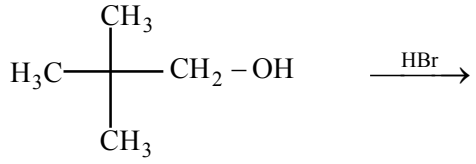
d) Compare the acidic/basic strength of the given pairs of compounds with proper justification. ***(any two)*** 2×2

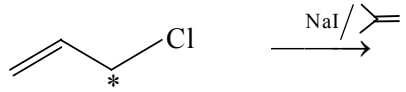
i) basicity of  NH_2 and NEt_3

ii) acidity of CF_3CO_2H and CF_3CH_2COOH

iii) acidity of *m*- and *p*- nitrophenol.

e) Predict the product(s) with plausible mechanism ***(any one)*** : 3

i) 

ii) 

GROUP - C

Answer **Question No. *3*** or **Question No. *4***.

3. i) Calculate the exchange energy for d^3 and p^3 electronic configurations. 3

ii) Find the ground state Term Symbol for $_7N$ and $_{11}Na$. 3

iii) Show that Bohr's 2nd postulate involving the quantization of the angular momentum can be derived from de Broglie's hypothesis. 2

iv) Explain the presence of 10 lines in the Na spectrum in weak magnetic field. 4

v) Write the electronic configuration of isoelectronic Mn and Co^{2+} (Both having 25 electrons) 2

vi) Calculate the wave length of the 4th line in the Balmer series of He^+ spectrum. 2