Ex/Int/CH/VS/19/2018

INTER B.SC. EXAMINATION, 2018

(1st Semester)

CHEMISTRY (SUBSIDIARY)

PAPER - VS

Time : Two hours Full Marks : 50

Use a separate answerscript for each group.

GROUP - A

1. a) Two reversible Carnot heat engines operate with different source temperatures T_1 and $T_2(T_1 > T_2)$, but the same sink temperature T. Which one is more efficient and why ?

   b) An adiabatic process must be isoentropic – justify / criticise.

   c) Three moles of $N_2(g)$, originally at 1 atm pressure are mixed isothermally with 5 moles of $H_2(g)$, also at 1 atm pressure to yield a mixture whose total pressure is 1 atm. Assuming the gases to be ideal, calculate i) the total entropy of mixing, and ii) the entropy of mixing per mole of gas. 2+2+3

2. a) Prove that $\Delta A_T = \Delta G_T$ for an isothermal change of an ideal gas, where ΔA and ΔG represent the changes in Helmholtz and Gibbs free energy, respectively.

b) How does the Gibbs free energy of any pure substance vary with temperature ? 3+2

3. a) What is Trouton's rule ? Under what conditions, is this rule valid ?

b) Why is the change of boiling point with pressure nearly the same for all liquids of about the same boiling point, but the change of freezing point widely different ?

c) Define chemical potential. 2+2+1

b) i) Explain the non-existence of He_2 and existence of He_2^+. 2

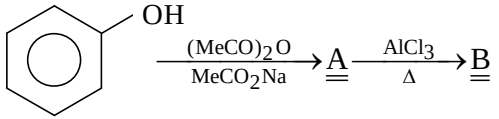
ii) Why Graphite is conductor and diamond is nonconductor, although chemical analysis shows that they are only C (Carbon) ? 2

c) Construct Molecular Orbital diagram of CO and explain the coordination of CO through C to Ni(0) in $[Ni(CO)_4]$ although O is more electronegative than C. 4

d) Explain the role of lone electron pair on the structure of molecules. Hence, predict the most stable structure of XeF_2, ICl_2^-, SF_4. 4

e) Using band theory, explain the conductivity, semiconductivity and insulating properties of materials. 4

f) What is hybridization ? How does hybridization regulate the structure of the molecules ? Explain the acidity order : acetylene > ethylene > ethane. 4

d) 

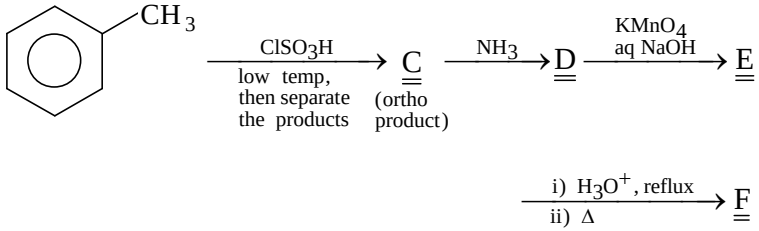
[mechanism not necessary]

7. Write short note on ***any one*** of the following : $1\frac{1}{2}$

   a) Reimer-Tiemann reaction.

   b) Phenol-formaldehyde resin.

8. a) Complete the following sequence of reactions and write the structures C – F 2



GROUP - C

Attempt ***any four*** Questions.

9. a) Define Molecular Orbital. How it differs from Atomic Orbital ? Using two atomic functions Φ_1 and Φ_2 of two H atoms construct MOs of H_2 molecule and determine the electronic configuration of the molecule. 4

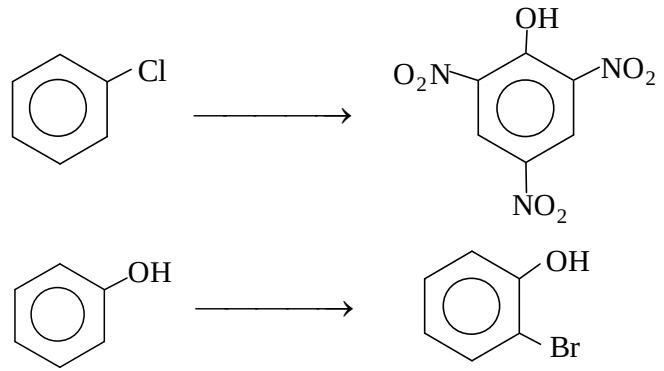
GROUP - B

4. a) Schematically describe one commercial method of preparation of phenol. 2

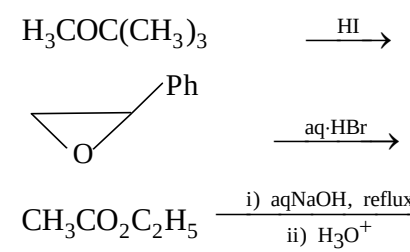
   b) Arrange phenol, cyclohexanol and benzoic acid in order of their relative acid strength and account for your answer. 3

   c) Write one suitable method of preparation of *tert*-butyl acetate. 1

5. Carry out the following transformation ***(any one)*** : $1\frac{1}{2}$



6. Predict the product/(s) with plausible mechanism ***(any three)*** : 2×3



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