SAMPLE PAPER

2019 JEE ADVANCED

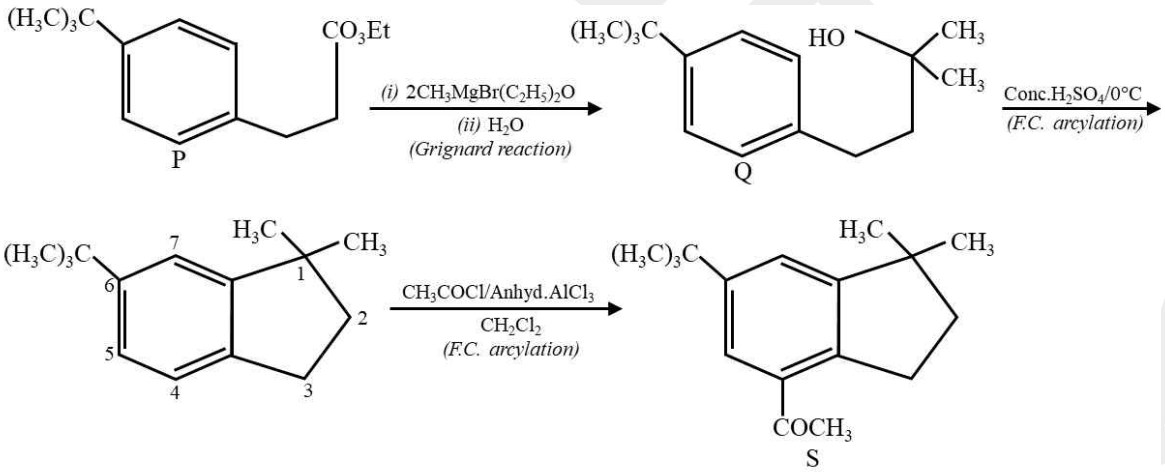
CHEMISTRY

SET–1

Roll No. | | | | | | | |

ANSWER AND SOLUTION

1. Thus, option (a) is correct,



2. Due to steric hindrance at positions 5 and 7, F.C. acylation occurs at position 4 to give product (S). Thus, option (c) is correct.

3.

$$Cl_2 + SO_2 \xrightarrow{\text{charcoal}} \underset{\text{Sulphuryl chloride (R)}}{SO_2Cl_2}$$

$$10SO_2Cl_2 + P_4 \longrightarrow 10SO_2 + 4PCl_5\,(S)$$

$$PCl_5 + 4\,H_2O \longrightarrow 5\,HCl + \underset{\text{Orthophodphoric acid (T)}}{H_3PO_4}$$

Thus, R, S and T are respectively SO_2Cl_2, PCl_5 and H_3PO_4 and hence option (*a*) is correct.

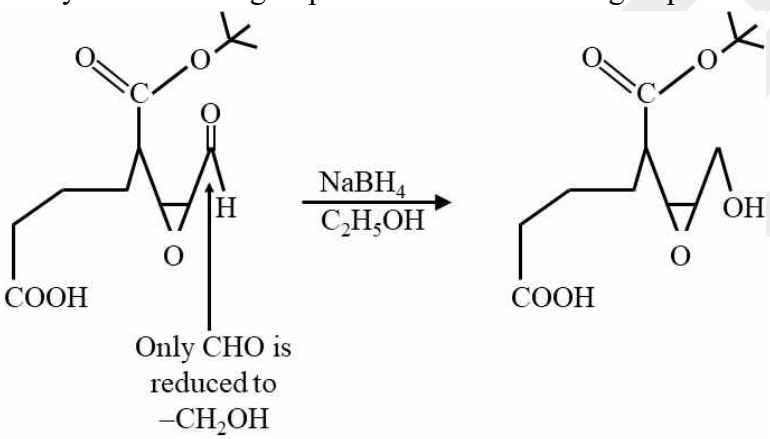
4.

$$Cl_2 + 2NaOH \xrightarrow{\text{Cold}} NaCl + \underset{\text{Sod. Hypochlorite (P)}}{NaClO}$$

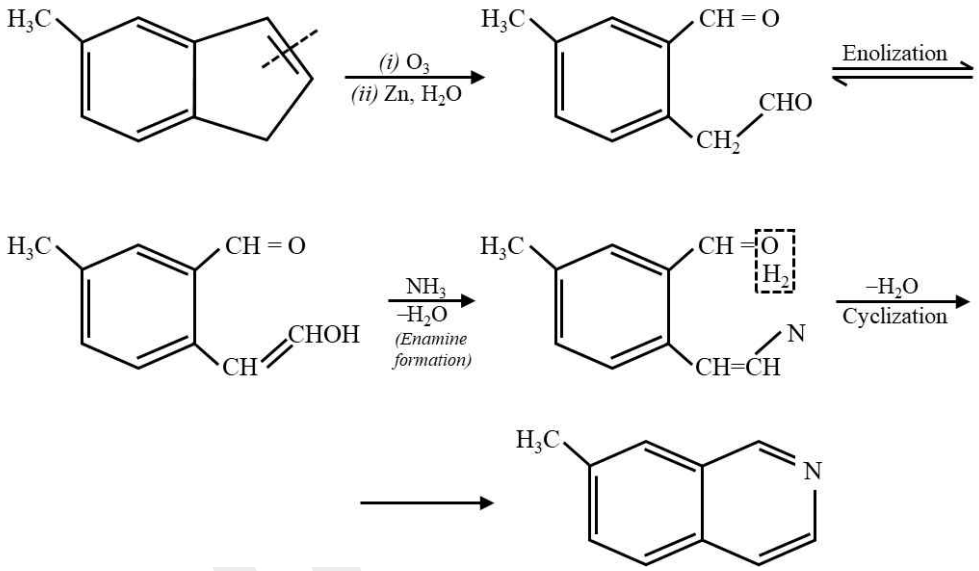
$$3\,Cl_2 + 6NaOH \longrightarrow 5\,NaCl + \underset{\text{Sod. chlorate (Q)}}{NaClO_3} + 3H_2O$$

Thus, NaClO (P) and $NaClO_3$ (Q) are the sodium salts of hypochlorus and chloric acid respectively and hence option (*a*) is correct.

5. $NaBH_4$ in C_2H_5OH neither reduces the acid and esters nor opens the epoxide ring. It reduces only the $-CHO$ group to the 1° alcoholic group.



6.



Thus, option (*a*) is correct.

7. As T increases, V.P. increases. Hence, options (c) and (d) are wrong.

$$\triangle T_f = K_f \times m$$

$$T_f^\circ - T_f = 2 \times \frac{34.5/46}{0.5}$$

$273 - T_f = 3$ or $T_f = 270$

Hence, only option (a) is correct.

8. Cell reaction is

$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

$\Delta G = \Delta G^\circ + 2.303\ RT \log Q$

$$= \Delta G^\circ + 2.303 RT \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

$$\Delta G^\circ = -nFE^\circ_{cell} = -2F(1.1)$$

$\therefore\ \Delta G^\circ = -2\ F\ (1.1) + 2.303\ RT \log 10$

$= 2.303\ RT - 2.2\ F$

9. In C_2^{2-}, total number of electrons = 14 (even).

Hence, it is diamagnetic

O_2^{2+} has bond order = 3, O_2 has bond order = 2.5. Hence, bond length in O_2^{2+} is less than that in O_2.

Bond order of N_2^{2+} = Bond order of N_2^{2-} = 2.5

Bond order of $He_2^+ = \frac{1}{2}$, i.e, it exists. Hence, Some energy is released when He_2^+ is formed from two isolated He atoms.

10. It is observed that presence of other soluble substances (impurities) affects the surface tension of the liquid considerably. The impurities which tend to concentrate on the surface of the liquid compared to its bulk lower the surface tension. For this reason, substances like soaps, detergents ($CH_3(CH_2)_{11}SO^-_3\ Na^+$) decrease the surface tension sharply upto CMC and then remains almost unchanged whereas substances like CH_3OH, C_2H_5OH, etc. lower the surface tension slightly. Inorganic impurities (like KCl) are present in the bulk of the liquid and tend to increase the surface tension of water.

11.

$$\underset{s}{Ag_2CrO_4} \rightleftharpoons \underset{2s+0.1}{2Ag^+} + \underset{s}{CrO_4^{2-}}$$

$(0.1 \text{ from } AgNO_3)$
$\cong 0.1\ M$

(as s is negligible in comparison to 0.1)

$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$

$1.1 \times 10^{-12} = (0.1)^2 \times s$ or $s = 1.1 \times 10^{-10}$ M

12. Carbocation (I) is stabilized by +R-effect of O as well as +I-effect of two CH_3 groups; carbocation (II) is stabilized by +I-effect of CH_3 and $CH_2CH(CH_3)_2$ groups; carbocation (III) is stabilized by +R-effect of O and +I-effect of one CH_3 group while carbocation (IV) is stabilized by +I-effect of $CH_2CHCH(CH_3)_2$ group. Thus, decreasing order of stability of these carbocations is :
I > III > II > IV.

13. Depending upon conditions, (I) may undergo substitution by S_{N^1} or S_{N^2} mechanism but (II) undergoes substitution by S_{N^2} mechanism. Thus, option (a) is correct. Compound (IV) being an, optically active halide always undergoes inversion of configuration. Therefore, option (b) is correct. The order of reactivity is : III > I > IV.
Thus, option (c) is wrong.

14. (b), (c), (d)
    (a) is incorrect because for any atom in the top most layer, coordination number is not 12 as there is no layer above the topmost layer.
    (b) is a known fact.
    (c) is correct because in *ccp* (*fcc*), number of atoms per unit cell is 4. Hence, octahedral voids = 4 and tetrahedral voids = 8. Therefore, number of octahedral voids per atom = 1 and number of tetrahedral voids per atom = 2.
    (d) For *ccp* (*fcc*), $r = \frac{a}{2\sqrt{2}}$ or $a = 2\sqrt{2}r$

15. (c) is wrong because frequency factor gives total number of collisions and not effective collisions cm^{-3} sec^{-1}.
(d) is wrong because half-life of the reaction decreases with increase of temperature (as reaction becomes faster).

16. (a), (b), (c)
(a) Cr^{2+} is a reducing agent as it gets oxidized to Cr^{3+} ($3d^3$ or t^3_{2g} which is a stable half-filled configuration).
(b) Mn^{3+} is and oxidizing agent as it gets reduced to Mn^{2+} ($3d^5$ which is more stable half-filled configuration).
(c) Cr (24) = $3d^4 4s^2$ $\quad\therefore\ Cr^{2+} = 3d^4$
Mn (25) = $3d^5 4s^2$ $\quad\therefore\ Mn^{3+} = 3d^4$
Thus, both Cr^{2+} and Mn^{3+} have d^4 electronic configuration.
(d) When Cr^{2+} is used as a reducing agent, it is oxidized to Cr^{3+} which has d^3 and not d^5 configuration.

17. Each complex ion in the pair $[Co(NH_3)_4Cl_2]^+$, $[Pt(NH_3)_2(H_2O)Cl]^-$ shows geometrical isomerism. Each complex in the pair $[Pt(NH_3)_3(NO_3)]Cl$, $[Pt(NH_3)_3Cl]$ Br shows ionization isomerism. In other pairs, the two complexes/ions do not show the same type of isomerism.

18. As the vessel is thermally insulated, the process is adiabatic and, therefore, $q = 0$.
Also $P_{ext} = 0$, therefore, $w = 0$
From 1st law of thermodynamics, $\Delta U = q + w$
$\therefore \quad \Delta U = 0 + 0 = 0$
But internal energy of an ideal gas is a function of temperature, therefore, $\Delta T = 0$, i.e., $T_2 = T_1$
Applying ideal gas equation $PV = nRT$.
As n, R and T are constant, $P_1V_1 = P_2V_2$
Equation PV^γ = constant is applicable only for an ideal gas in reversible adiabatic process. Hence, $P_2V_2^\gamma = P_1V_1^\gamma$ is not applicable.