IIT-JEE 2010 Chemistry Paper II

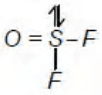
PART I - Chemistry

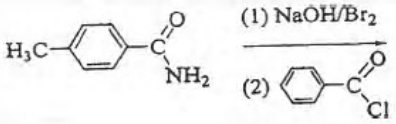
SECTION - I

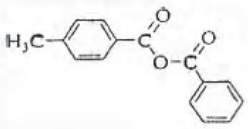
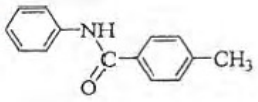
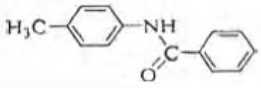
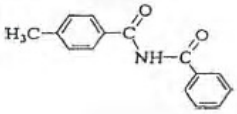
Single Correct Choice Type

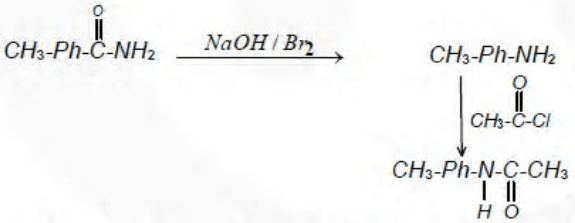
This Section contain **6 multiple choice questions. Each** question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

1. The species having pyramidal shape is
(A) SO_3 (B) BrF_3 (C) SiO_32- (D) OSF_2

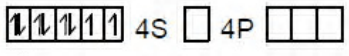
1. (D) 

2. In the reaction  the structure of the product *T* is

(A) 
(B) 
(C) 
(D) 

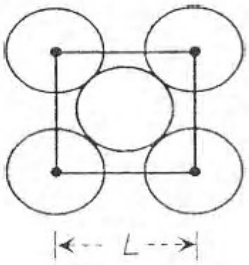
2. (C) 

3. The complex showing a spin-only magnetic moment of 2.82 B.M.is
(A) $Ni(CO)_4$ (B) $[NiCl_4]^{2-}$ (C) $Ni(PPh_3)_4$ (D) $[Ni(CN)_4]^{2-}$

3. (B) $Ni^{+2} = Ar3d$  4S ☐ 4P ☐☐☐

$\mu = \sqrt{n(n+2)} = 2.82$ BM

4. The packing efficiency of the two-dimensional square unit cell shown below is



(A) 39.27 % (B) 68.02 % (C) 74.05 % (D) 78.54 %

4. (D) $p.f. = \frac{2 \times \pi r^2}{a^2}$ $a = 2\sqrt{2}r$

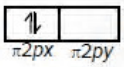
$= \frac{2 \times \pi r^2}{8r^2} = \frac{3.14 \times 100}{4} = 78.5\ \%$

5. Assuming that Hund's rule is violated, the bond order and magnetic nature of diatomic molecule B_2 is

(A) 1 and diamagnetic (B) 0 and diamagnetic

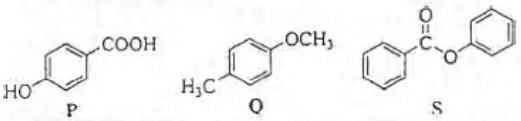
(C) 1 and paramagnetic (D) 0 and paramagnetic

5. (A) $BO = (1/2) \times 2 = 1$ 

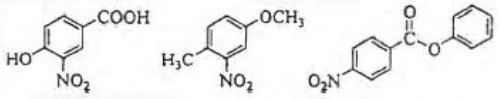
and no unpaired electron 

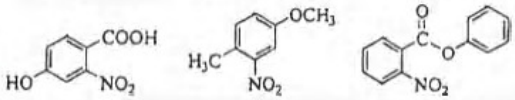
defying Hund's rule

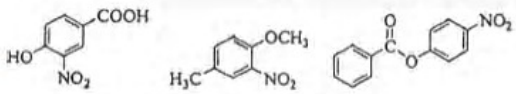
6. The compounds P,Q and S

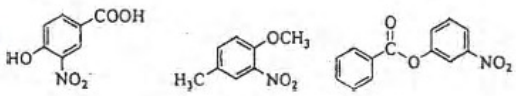


were separately subjected to nitration using HNO_3 / H_2SO_4 mixture. The major product formed in each case respectively, is

(A) 

(B) 

(C) 

(D) 

6. (C) Electrophilic - substitution takes place at electron rich site.

SECTION - II
Integer Type

This Section contains a group of **5 questions**. The answer to each of the questions a **single-digit integer, ranging** from 0 to 9. The correct digit below the question no. in the ORS is to be bubbled.

7. Silver (atomic weight = 108 g $^{mol-1}$) has a density of 10.5 gcm^{-3}. The number of silver atoms on a surface of area 10^{-12} m^2 can be expressed in scientific notation as $y \times 10^X$. The value of x is

7. (7) $d = (4 \times 108) / (N \times a^3)$

$a^3 = (4 \times 108) / (10.5 \times 6 \times 10^{23})$

$= (4 \times 18) \times 10^{-23} / (10.5)$

$= 6.857 \times 10^{-23}$

$= 68.57 \times 10^{-24}$

$\therefore a = 4 \times 10^{-8}$ cm

$= 4 \times 10^{-10}$ m

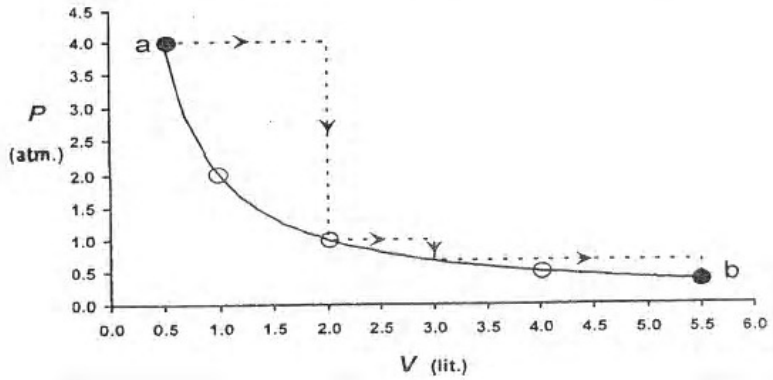
$a^2 = 16 \times 10^{-20}$ m^2

$\therefore$ number of unit base $= (10^{-12}) / (16 \times 10^{-20}) = (10^{+8} / 16)$

number of atoms $= (1 / 8) \times 10^8 = 1.25 \times 10^7$

$\therefore x = 7$

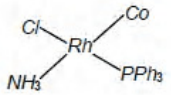
8. One mole of an ideal gas is taken from **a** to **b** along two paths denoted by the solid and the dashed lines as shown in the graph below. If the work done along the solid line path is W_s and that along the dotted line path is W_d, then the integer closest to the ratio W_d / W_s is



8. (2) $W_d = 4 \times 1.5 + 1 \times 1 + .75 \times 2.5 = 9$
$W_s = 2.3\ nRT \log (V_2 / V_1)$
$= 2.3 \times 2 \log (5.5 / .5)$
$= 4.6 \log 11 = 4.6$
$(W_d / d_s) = (9 / 4.6) \approx 2$

9. Total number of geometrical isomers for the complex $[RhCl(CO)(PPh_3)(NH_3)]$ is

9. (3)



This can exists only in three geometrical form

10. Among the following, the number of elements showing only one non-zero oxidation state is
O, *Cl*, *F*, *N*, *P*, *Sn*, *Tl*, *Na*, *Ti*

10. (2) Only *F* and *Na* can exist in one non zero oxidation state.

11. The total number of diprotic acids among the following is
H_3PO_4 H_2SO_4 H_3PO_3 H_2CO_3 $H_2S_2O_7$
H_3BO_3 H_3PO_2 H_2CrO_4 H_2SO_3

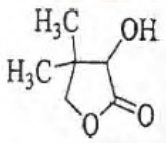
11. **(6)** H_2SO_4, H_3PO_3, H_2CO_3, $H_2S_2O_7$, H_2CrO_4, H_2SO_3

Section - III (Paragraph Type)

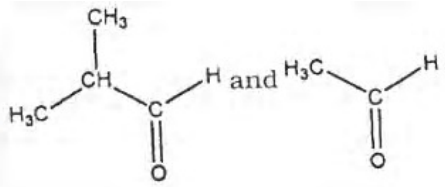
This section contains 2 paragraphs. Based upon each of the paragraphs 3 multiple choice questions have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.

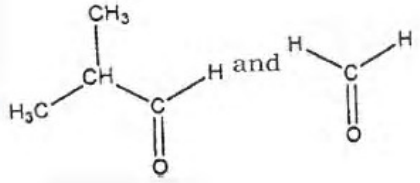
Paragraph for questions 12 to 14

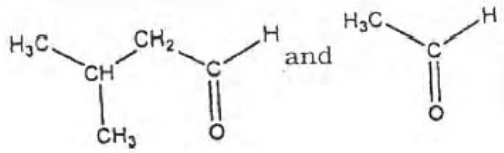
Two aliphatic aldehydes *P* and *Q* react in the presence of aqueous K_2CO_3 to give compound *R*, which upon treatment with *HCN* provides compound *S*. On acidification and heating, *S* gives the product shown below :

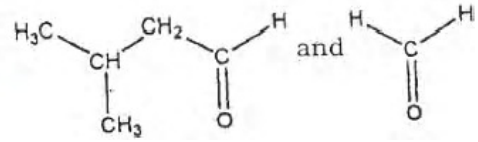


12. The compounds *P* and *Q* respectively are

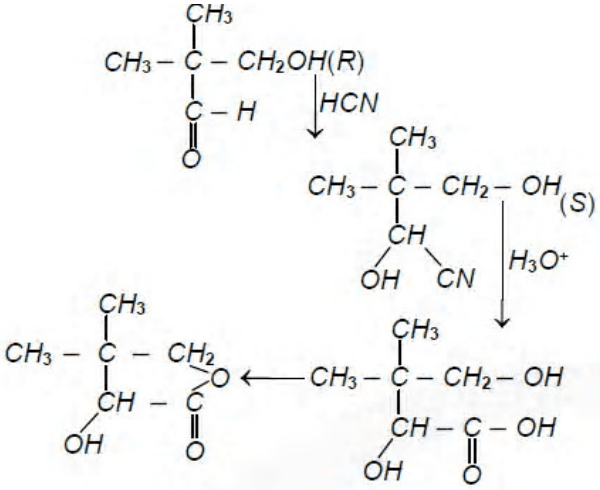
(A) 

(B) 

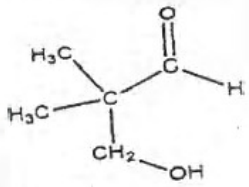
(C) 

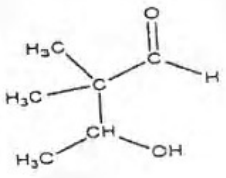
(D) 

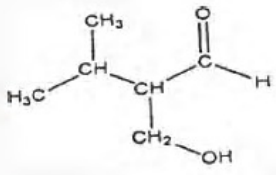
12. **(B)**

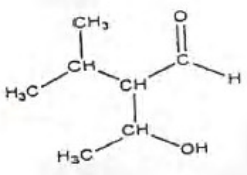


13. The compound *R* is

(A) 

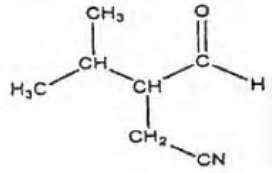
(B) 

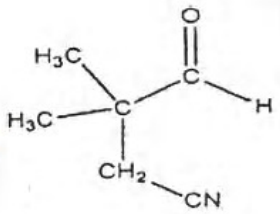
(C) 

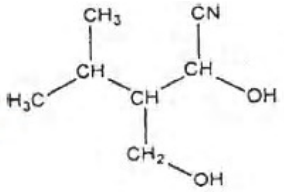
(D) 

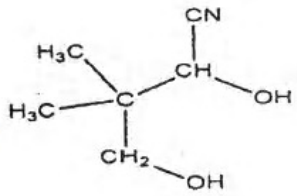
13. **(A)** Answer given above

14. The compound *S* is

(A) 

(B) 

(C) 

(D) 

14. **(D)** Answer given above

Paragraph for questions 15 to 17

The hydrogen-like species Li^{2+} is in a spherically symmetric state S_1 with one radial node. Upon absorbing light the ion undergoes transition to a state S_2. The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

15. The state S_1 is
(A) 1s (B) 2s (C) 2p (D) 3s

15. **(B)** It should be a 2s orbital (S_1). From this it has gone to 2p (S_2) both having one radial node.

16. Energy of the state S_1 in units of the hydrogen atom ground state energy is
(A) 0.75 (B) 1.50 (C) 2.25 (D) 4.50

16. **(C)** '*H*' has = 13.6 eV
Li^{+2} has = 13.6 × 9
∴ Li^{+2} in 2nd state = (13.6 × 9 / 4) = 13.6 × 2.5

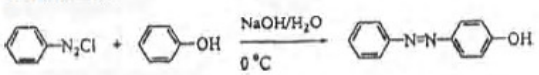
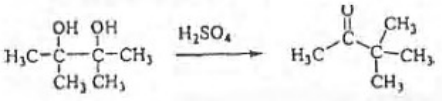
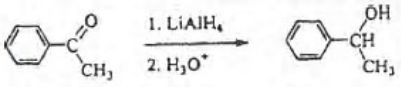
17. The orbital angular momentum quantum number of the state S_2 is
(A) 0 (B) 1 (C) 2 (D) 3

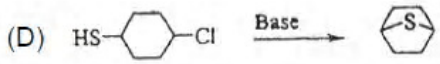
17. **(B)** It is in 2p level

Section - IV (Matrix Type)

This Section contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and five statements (P, Q, R, S and T) in Column II. Any given statement in Column I can have correct matching with one or more statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for that particular question, against statement B, darken the bubbles corresponding to Q and R in the *ORS*.

18. Match the reactions in Column I with appropriate options in Column II

Column I		Column II
(A)		(P) Racemic mixture
(B)		(Q) Addition reaction
(C)		(R) Substitution reaction

(D) 

(S) Coupling reaction

(T) Carbocation intermediate

18. (A) – (RS) Diazonium ion goes for coupling via substitution
(B) – (T) Pinacole pinacolone goes through +ve ion intermediate
(C) – (PQ) It goes nucleophilic addition reaction through a complex formation
(D) – (R) SH is acidic with base. It is 1st converted into a nucleophile and then gives intra substitution.

19. All the compounds listed in Column I react with water. Match the result of the respective reactions with the appropriate options listed in Column II.

Column I	Column II
(A) $(CH_3)_2SiCl_2$	(P) Hydrogen halide formation
(B) XeF_4	(Q) Redox reaction
(C) Cl_2	(R) Reacts with glass
(D) VCl_5	(S) Polymerization
	(T) O_2 formation

19. A – (PS)

$$(CH_3)_2SiCl_2 \xrightarrow[-HCl]{+2H_2O} (CH_3)_2Si(OH)_2 \xrightarrow{-H_2O} OH-\overset{R}{\underset{R}{Si}}-O-\overset{R}{\underset{R}{Si}}-$$

B-(PQRT)

$$2XeF_4 + 3H_2O \Rightarrow Xe + XeO_3 + 3H_2F_2 + F_2$$
$$6XeF_4 + 12H_2O \Rightarrow 4Xe + 2XeO_3 + 12H_2F_2 + 3O_2$$
$$6HF + SiO_2 \rightarrow H_2SiF_6 + 2H_2O$$

C-(PQT)

$$2Cl_2 + 2H_2O \longrightarrow 4HCl + O_2$$

D-(PQTS)

VCl_5(unstable) $\longrightarrow$ VCl_3 (can polymerize) + Cl_2 $\longrightarrow$ can give HCl and O_2