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# IIT-JEE-2010

PAPER 2

CODE

0

Time: 3 Hours

*Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.*

## INSTRUCTIONS

### A. General:

1. This Question Paper contains 32 pages having 57 questions.
2. The **question paper CODE** is printed on the right hand top corner of this sheet and also on the back page (page no. 32) of this booklet.
3. No additional sheets will be provided for rough work.
4. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed.
5. Log and Antilog tables are given in page numbers 30 and 31 respectively.
6. The answer sheet, a machine-gradable Objective Response Sheet (**ORS**), is provided separately.
7. Do not Tamper / Mutilate the ORS or this booklet.
8. Do not break the seals of the question – paper booklet before instructed to do so by the invigilators.

### B. Filling the bottom-half of the ORS:

9. The ORS has CODE printed on its lower and upper Parts.
10. Make sure the CODE on the **ORS** is the same as that on this booklet. If the Codes do not match, ask **for a change of the Booklet.**
11. Write your Registration No., Name and Name of centre and sign with pen in appropriate boxes. Do not write these anywhere else.
12. Darken the appropriate bubbles under each digit of your Registration No. with HB Pencil.

### C. Question paper format and Marking scheme:

13. The question paper consists of **3 parts** (Chemistry, Mathematics and Physics). Each part consists of **four** Sections.
14. For each question in **Section I**: you will be awarded **5 marks** if you **darken only the bubble** corresponding to the correct answer and **zero** mark if no bubbles are darkened. In all other cases, **minus two (-2) mark** will be awarded.
15. For each question in **Section II**: you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and **zero mark** if no bubbles are darkened. No negative marks will be awarded for incorrect answers in this Section.
16. For each question in **Section III**: you will be awarded **3 marks** if you darken **only** the bubble corresponding to the correct answer and **zero** mark if no bubbles are darkened. In all other cases, **minus one (-1) mark** will be awarded.
17. For each question in Section IV: you will be awarded 2 marks for each row in which your darkened the bubbles(s) corresponding to the correct answer. Thus each question in this section carries a maximum of 8 marks. There is no negative marks awarded for incorrect answer(s) in this Section.

Write your name, registration number and sign in the space provided on the back page of this booklet.

### Useful Data

Atomic Numbers: B 5; C 6; N 7; O 8; F 9; Na 11; Si 14; P 15; S 16; Cl 17; Ti 22;  
V 23; Cr 24; Ni 28; Cu 29; Br 35; Rh 45; Sn 50; Xe 54; Tl 81.

|         |   |                    |  |
|---------|---|--------------------|--|
| 1 amu = | $1.66 \times 10^{-27} \text{ kg}$             | e =                | $1.6 \times 10^{-19} \text{ C}$                                  |
| R =     | $0.082 \text{ L-atm K}^{-1} \text{ mol}^{-1}$ | c =                | $3.0 \times 10^8 \text{ m s}^{-1}$                               |
| h =     | $6.626 \times 10^{-34} \text{ J s}$           | F =                | $96500 \text{ C mol}^{-1}$                                       |
| $N_A$ = | $6.022 \times 10^{23}$                        | $R_H$ =            | $2.18 \times 10^{-18} \text{ J}$                                 |
| $m_e$ = | $9.1 \times 10^{-31} \text{ kg}$              | $4\pi\epsilon_0$ = | $1.11 \times 10^{-10} \text{ J}^{-1} \text{ C}^2 \text{ m}^{-1}$ |

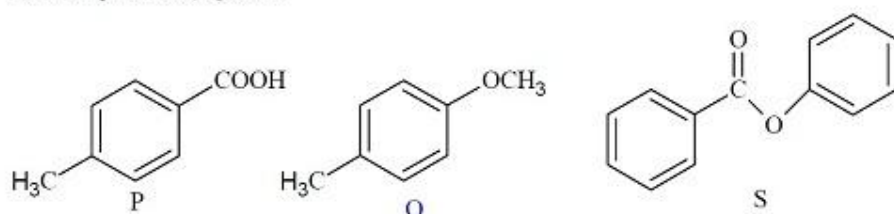
**IITJEE 2010 PAPER-2 [Code – 0]**

**PART - I: CHEMISTRY**

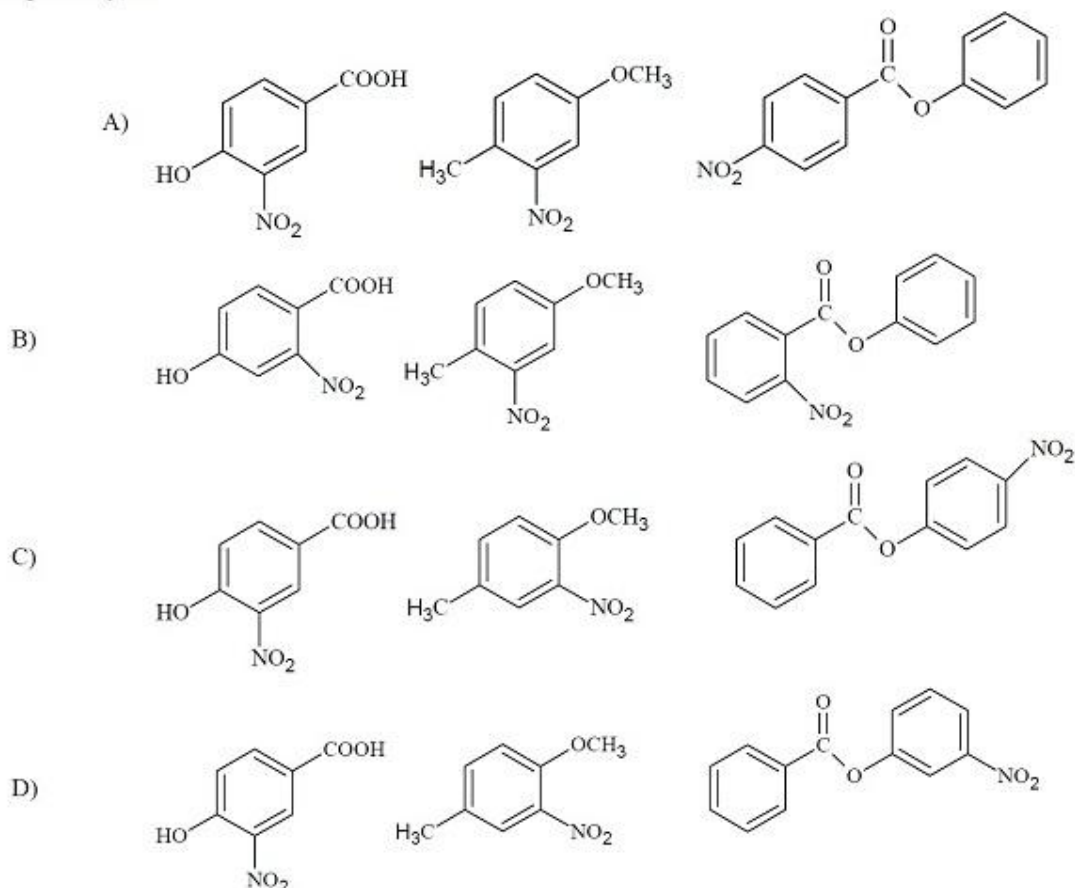
SECTION – I (Single Correct Choice Type)

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

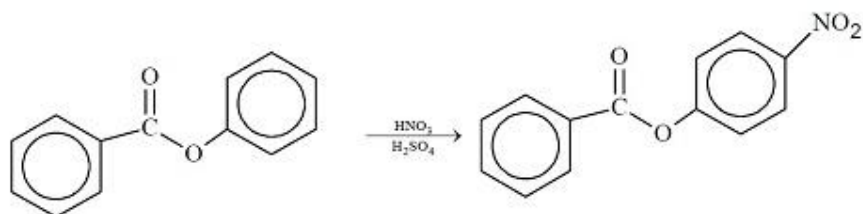
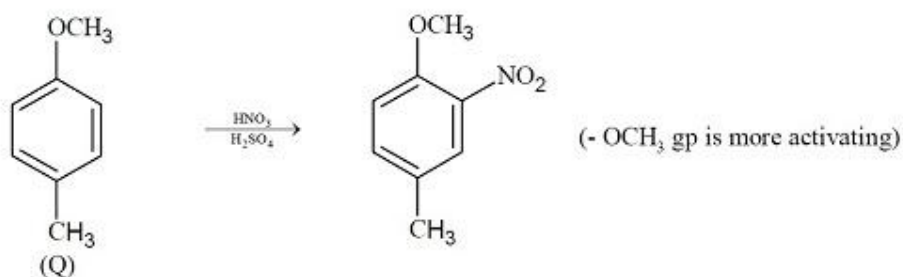
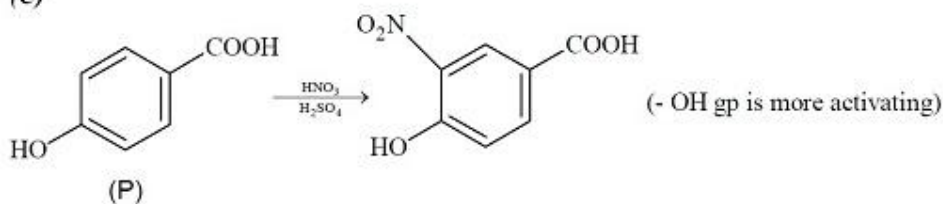
\*1. The compounds P, Q and S



were separately subjected to nitration using  $\text{HNO}_3/\text{H}_2\text{SO}_4$  mixture. The major product formed in each case respectively, is

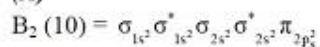


Sol. (C)



- \*2. Assuming that Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B<sub>2</sub> is
- |                       |                       |
|-----------------------|-----------------------|
| A) 1 and diamagnetic  | B) 0 and diamagnetic  |
| C) 1 and paramagnetic | D) 0 and paramagnetic |

Sol. (A)



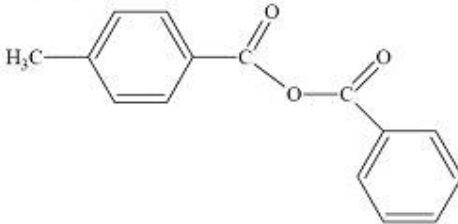
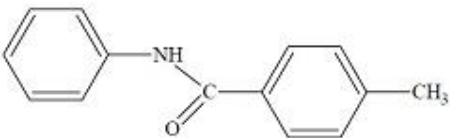
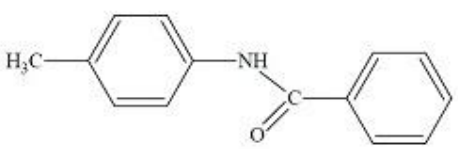
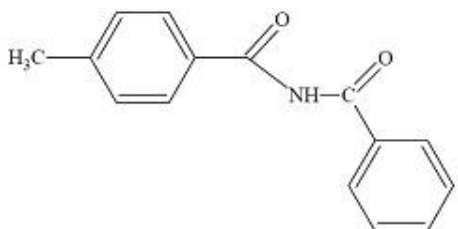
$$\text{Bond order} = \frac{6-4}{2} = 1$$

(nature diamagnetic as no unpaired electron)

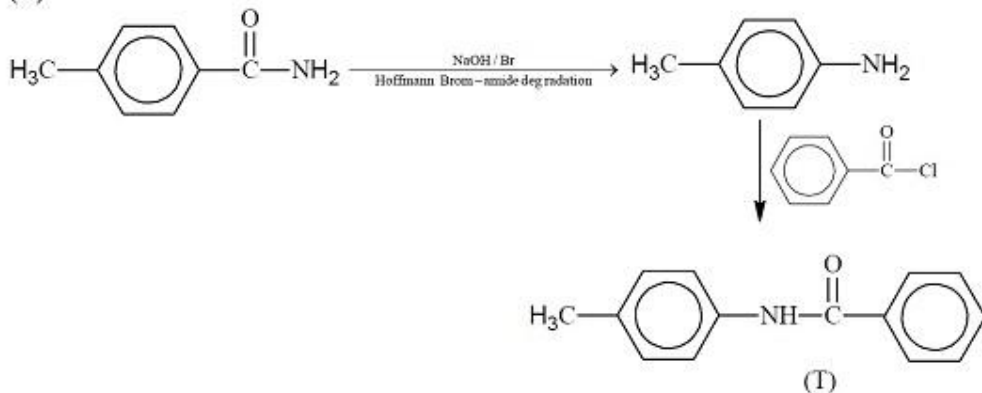


5. In the reaction  $\text{H}_3\text{C}-\text{C}_6\text{H}_4-\text{C}(=\text{O})\text{NH}_2 \xrightarrow[\text{(2) } \text{C}_6\text{H}_5\text{COCl}]{\text{(1) NaOH/Br}_2} \text{T}$  the structure of the

Product T is

- A)  B) 
- C)  D) 

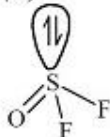
Sol. (C)



\*6. The species having pyramidal shape is

- A)  $\text{SO}_3$  B)  $\text{BrF}_3$   
 C)  $\text{SiO}_3^{2-}$  D)  $\text{OSF}_2$

Sol. (D)



SECTION-II (Integer Type)

This Section contains 5 questions. The answer to each question is 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 =  $108 \text{ g mol}^{-1}$ ) has a density of  $10.5 \text{ g cm}^{-3}$ . The number of silver atoms on a surface of area  $10^{-12} \text{ m}^2$  can be expressed in scientific notation as  $y \times 10^x$ . The value of x is

*Sol.* 7

$$d = \frac{\text{mass}}{V} \Rightarrow 10.5 \text{ g/cc means in 1 cc} \Rightarrow 10.5 \text{ g of Ag is present.}$$

$$\text{Number of atoms of Ag in 1 cc} \Rightarrow \frac{10.5}{108} \times N_A$$

$$\text{In 1 cm, number of atoms of Ag} = \sqrt[3]{\frac{10.5}{108} N_A}$$

$$\text{In 1 cm}^2, \text{ number of atoms of Ag} = \left(\frac{10.5}{108} N_A\right)^{2/3}$$

$$\begin{aligned} \text{In } 10^{-12} \text{ m}^2 \text{ or } 10^{-8} \text{ cm}^2, \text{ number of atoms of Ag} &= \left(\frac{10.5}{108} N_A\right)^{2/3} \times 10^{-8} = \left(\frac{1.05 \times 6.022 \times 10^{24}}{108}\right)^{2/3} \times 10^{-8} \\ &= 1.5 \times 10^7 \end{aligned}$$

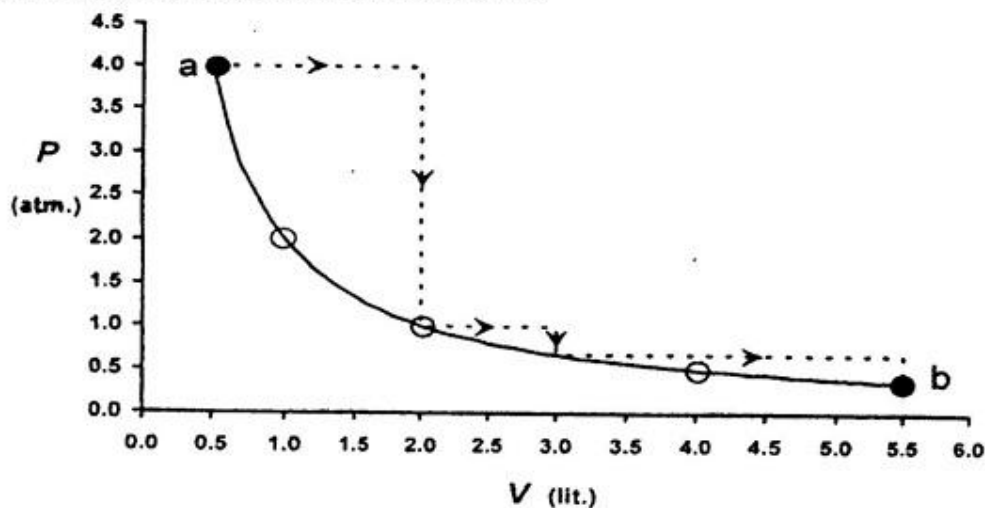
Hence  $x = 7$

\*8. Among the following, the number of elements showing only one non-zero oxidation state is O, Cl, F, N, P, Sn, Tl, Na, Ti

*Sol.* 2

Na, F show only one non-zero oxidation state.

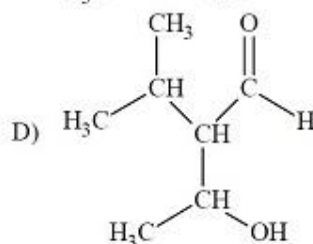
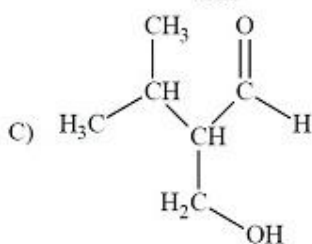
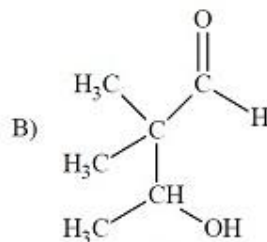
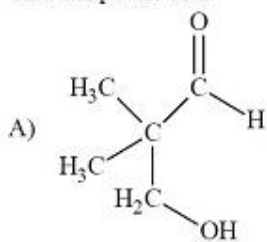
\*9. One mole of an ideal gas is taken from a to b along two paths denoted by the solid and the dashed lines as shown in the graph below. If the work done along the solid line path is  $w_s$  and that along the dotted line path is  $w_d$ , then the integer closest to the ratio  $w_d/w_s$  is





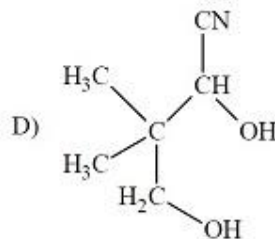
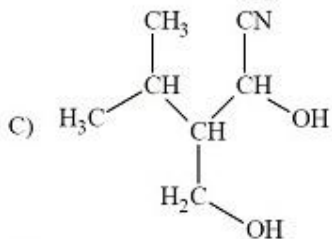
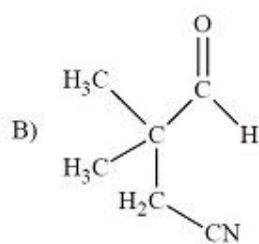
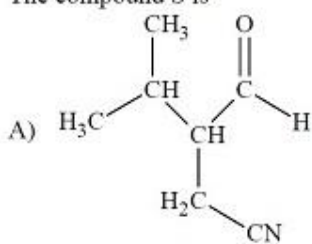


13. The compound R is



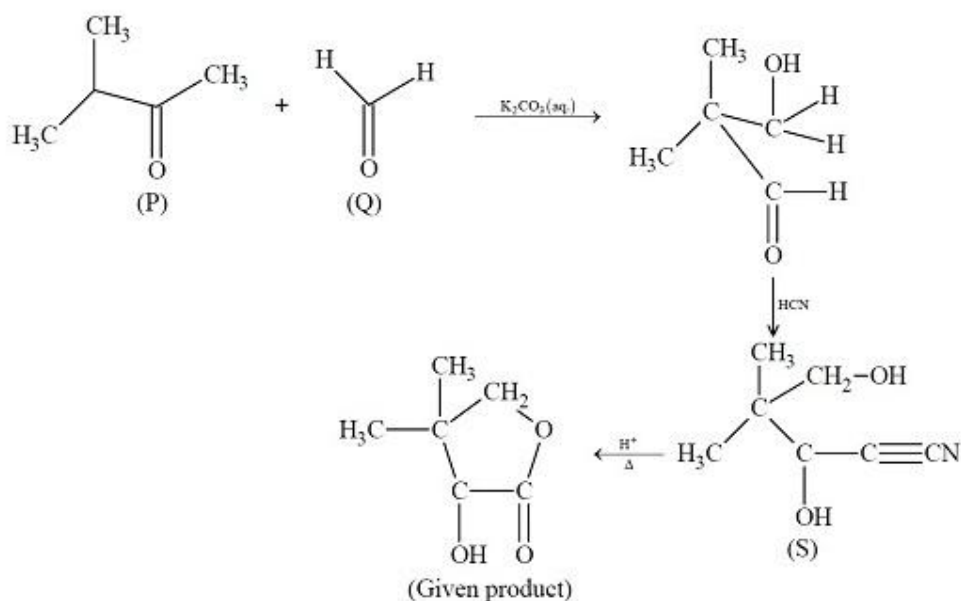
*Sol.* (A)

14. The compound S is



*Sol.* (D)

*Sol:* (12 to 14)



**Paragraph for questions 15 to 17**

The hydrogen-like species  $\text{Li}^{2+}$  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

**Sol.** (B)  
 For,  $S_1$  (spherically symmetrical)  
 node = 1

$$\Rightarrow n - 1 = 1$$

$$n = 2$$

For  $S_2$ , radial node = 1

$$E_{S_2} = \frac{-13.6 \times Z^2}{n^2} = E_{\text{H}} \text{ in ground state} = -13.6$$

$$E = \frac{-13.6 \times 9}{n^2} \Rightarrow n = 3$$

So, state  $S_1$  is 2s and  $S_2$  is 3p.

- \*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

**Sol.** (C)  


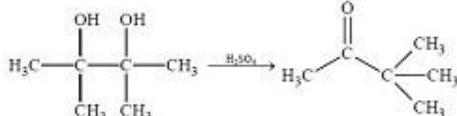
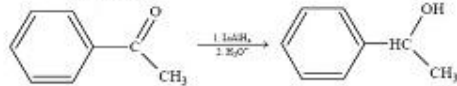
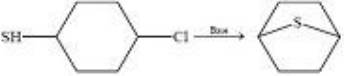
$$\frac{E_{S_1}}{E_{\text{H(ground)}}} = \frac{-13.6 \times 9}{4 \times (-13.6)} = 2.25$$

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

**Sol.** (B)  
 Azimuthal quantum number for  $S_2 = \ell = 1$

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.

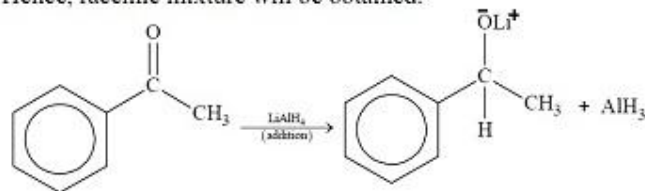
18. Match the reactions in Column I with appropriate options in Column II.
- | Column I  | Column II                   |
|---|-----------------------------|
| A)  | p) Racemic mixture          |
| B)   | q) Addition reaction        |
| C)   | r) Substitution reaction    |
| D)   | s) Coupling reaction        |
|   | t) Carbocation intermediate |

Sol. (A - r, s, t); (B - t); (C - p, q); (D - r)

(A) It is an example of electrophilic substitution reaction which results in coupled product hence it is coupling reaction also.

(B) Pinacole-pinacolone rearrangement. In this reaction intermediate is carbocation.

(C) It is an example of addition reaction by carbonyl compounds and both enantiomers will be formed. Hence, racemic mixture will be obtained.

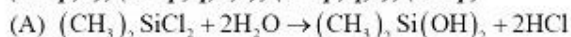


(D) It is an example of nucleophilic substitution.

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) $(\text{CH}_3)_2\text{SiCl}_2$ | p) Hydrogen halide formation |
| B) $\text{XeF}_4$                 | q) Redox reaction            |
| C) $\text{Cl}_2$                  | r) Reacts with glass         |
| D) $\text{VCl}_5$                 | s) Polymerization            |
|                                   | t) $\text{O}_2$ formation    |

Sol. (A - p, s); (B - p, q, r, t); (C - p, q, t); (D - p)



$(\text{CH}_3)_2\text{Si}(\text{OH})_2$  can undergo polymerization to form silicones.

