

CHEMISTRY
TEST PAPER WITH SOLUTION
SECTION-A

1. A commercially sold conc. HCl is 35% HCl by mass. If the density of this commercial acid is 1.46 g/mL, the molarity of this solution is :
(Atomic mass : Cl = 35.5 amu, H = 1 amu)
- (A) 10.2 M (B) 12.5 M
(C) 14.0 M (D) 18.2 M

Official Ans. by NTA (C)
Ans. (C)
Sol. Let total volume = 1000 mL = 1L

total mass of solution = 1460 g

$$\text{mass of HCl} = \frac{35}{100} \times 1460$$

$$\text{moles of HCl} = \frac{35 \times 1460}{100 \times 36.5}$$

$$\text{So molarity} = \frac{35 \times 1460}{100 \times 36.5} = 14\text{M}$$

2. An evacuated glass vessel weighs 40.0 g when empty, 135.0 g when filled with a liquid of density 0.95 g mL⁻¹ and 40.5 g when filled with an ideal gas at 0.82 atm at 250 K. The molar mass of the gas in g mol⁻¹ is :
(Given : R = 0.082 L atm K⁻¹ mol⁻¹)
- (A) 35 (B) 50
(C) 75 (D) 125

Official Ans. by NTA (D)
Ans. (D)
Sol. Mass of liquid = 135 – 40 = 95 g

$$\text{Volume of liquid} = \frac{\text{mass}}{\text{density}} = \frac{95}{.95} \text{ mL}$$

$$= 100 \text{ mL} = 0.1 \text{ L}$$

$$\text{mass of ideal gas} = 40.5 - 40 \text{ g} = 0.5 \text{ g}$$

$$PV = nRT$$

$$0.82 \times 0.1 = \left(\frac{0.5}{M} \right) \times 0.082 \times 250$$

$$M = 125$$

3. If the radius of the 3rd Bohr's orbit of hydrogen atom is r₃ and the radius of 4th Bohr's orbit is r₄. Then :

(A) r₄ = $\frac{9}{16}$ r₃ (B) r₄ = $\frac{16}{9}$ r₃

(C) r₄ = $\frac{3}{4}$ r₃ (D) r₄ = $\frac{4}{3}$ r₃

Official Ans. by NTA (B)
Ans. (B)

Sol. $r = 0.529 \times \frac{n^2}{Z} \text{ \AA}$

$$r_3 = 0.529 \times \frac{3^2}{1}$$

$$r_4 = 0.529 \times \frac{4^2}{1}$$

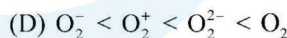
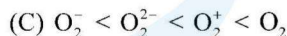
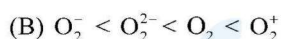
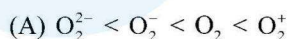
$$\frac{r_4}{r_3} = \frac{4^2}{3^2} = \frac{16}{9}$$

$$r_4 = \frac{16r_3}{9}$$

4. Consider the ions/molecule



For increasing bond order the correct option is :


Official Ans. by NTA (A)
Ans. (A)
Sol.

ion/molecule	Number of e ⁻ in BMO	Number of e ⁻ in ABMO	Bond order
O ₂ ⁺	10	5	2.5
O ₂	10	6	2
O ₂ ⁻	10	7	1.5
O ₂ ²⁻	10	8	1

Bond order $O_2^{2-} < O_2^- < O_2 < O_2^+$

5. The $\left(\frac{\partial E}{\partial T}\right)_p$ of different types of half cells are as follows :

A	B	C	D
1×10^{-4}	2×10^{-4}	0.1×10^{-4}	0.2×10^{-4}

(Where E is the electromotive force)

Which of the above half cells would be preferred to be used as reference electrode ?

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

Official Ans. by NTA (C)

Ans. (C)

- Sol.** A cell with less variation in EMF with temperature is preferred as reference electrode because it can be used for wider range of temperature without much derivation from standard value so a cell with less

$\left(\frac{\partial E}{\partial T}\right)_p$ is preferred.

6. Choose the correct stability order of group 13 elements in their +1 oxidation state.
(A) $Al < Ga < In < Tl$ (B) $Tl < In < Ga < Al$
(C) $Al < Ga < Tl < In$ (D) $Al < Tl < Ga < In$

Official Ans. by NTA (A)

Allen Ans. (A)

- Sol.** Moving down the group stability of lower oxidation state increases
 $Al < Ga < In < Tl$

7. Given below are two statements :

Statement I : According to the Ellingham diagram, any metal oxide with higher ΔG° is more stable than the one with lower ΔG° .

Statement II : The metal involved in the formation of oxide placed lower in the Ellingham diagram can reduce the oxide of a metal placed higher in the diagram.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

- (A) Both **Statement I** and **Statement II** are correct.

(B) Both **Statement I** and **Statement II** are incorrect.

(C) **Statement I** is correct but **Statement II** is incorrect.

(D) **Statement I** is incorrect but **Statement II** is correct.

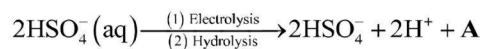
Official Ans. by NTA (D)

Ans. (D)

- Sol.** Metal oxide with lower ΔG° is more stable

Statement II is correct

8. Consider the following reaction :



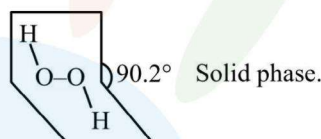
The dihedral angle in product A in its solid phase at 110 K is :

- (A) 104° (B) 111.5°
(C) 90.2° (D) 111.0°

Official Ans. by NTA (C)

Ans. (C)

- Sol.** $2HSO_4^-(aq) \xrightarrow[(2) \text{ Hydrolysis}]{(1) \text{ Electrolysis}} 2HSO_4^- + 2H^+ + H_2O_2$ (A)



9. The correct order of melting point is :

- (A) $Be > Mg > Ca > Sr$ (B) $Sr > Ca > Mg > Be$
(C) $Be > Ca > Mg > Sr$ (D) $Be > Ca > Sr > Mg$

Official Ans. by NTA (D)

Ans. (D)

- Sol.** M.P

Be 1560 K

Mg 924 K

Ca 1124 K

Sr 1062 K

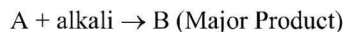
10. The correct order of melting points of hydrides of group 16 elements is :

- (A) $H_2S < H_2Se < H_2Te < H_2O$
(B) $H_2O < H_2S < H_2Se < H_2Te$
(C) $H_2S < H_2Te < H_2Se < H_2O$
(D) $H_2Se < H_2S < H_2Te < H_2O$

Official Ans. by NTA (A)

Ans. (A)

11. Consider the following reaction :



If B is an oxoacid of phosphorus with no P-H bond, then A is :

- (A) White P₄ (B) Red P₄
 (C) P₂O₃ (D) H₃PO₃

Official Ans. by NTA (B)

Ans. (Bonus)

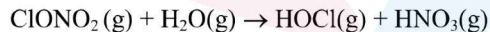
12. Polar stratospheric clouds facilitate the formation of :

- (A) ClONO₂ (B) HOCl
 (C) ClO (D) CH₄

Official Ans. by NTA (B)

Ans. (B)

Sol. Polar stratospheric clouds provide surface on which hydrolysis of ClONO₂ takes place to form HOCl (Hypochlorous acid)



13. Given below are two statements :

Statement I : In 'Lassaigne's Test, when both nitrogen and sulphur are present in an organic compound, sodium thiocyanate is formed.

Statement II : If both nitrogen and sulphur are present in an organic compound, then the excess of sodium used in sodium fusion will decompose the sodium thiocyanate formed to give NaCN and Na₂S.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

- (A) Both **Statement I** and **Statement II** are correct.
 (B) Both **Statement I** and **Statement II** are incorrect.

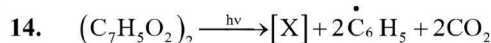
(C) **Statement I** is correct but **Statement II** is incorrect.

(D) **Statement I** is incorrect but **Statement II** is correct.

Official Ans. by NTA (A)

Ans. (A)

Sol. Both statement I & statement II are correct.

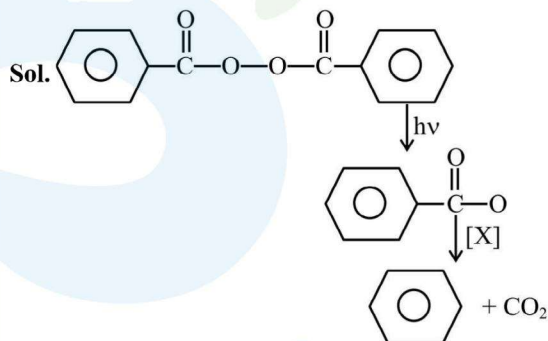


Consider the above reaction and identify the intermediate 'X'

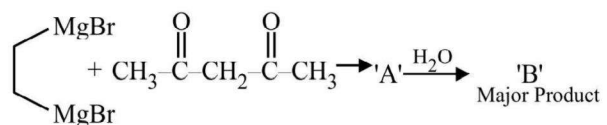
- (A) $\text{C}_6\text{H}_5-\overset{\text{O}}{\parallel}{\text{C}}^{\oplus}$ (B) $\text{C}_6\text{H}_5-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}^{\ominus}$
 (C) $\text{C}_6\text{H}_5-\overset{\text{O}}{\parallel}{\text{C}}-\ddot{\text{O}}$ (D) $\text{C}_6\text{H}_5-\overset{\text{O}}{\parallel}{\text{C}}-\ddot{\text{O}}\cdot$

Official Ans. by NTA (D)

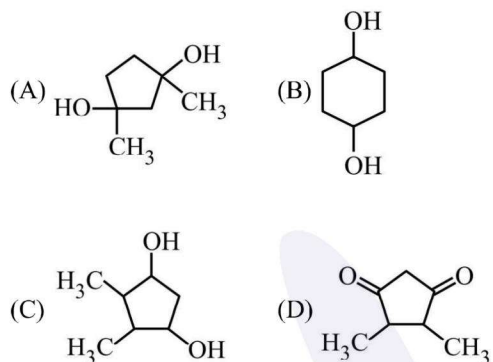
Ans. (D)



15.



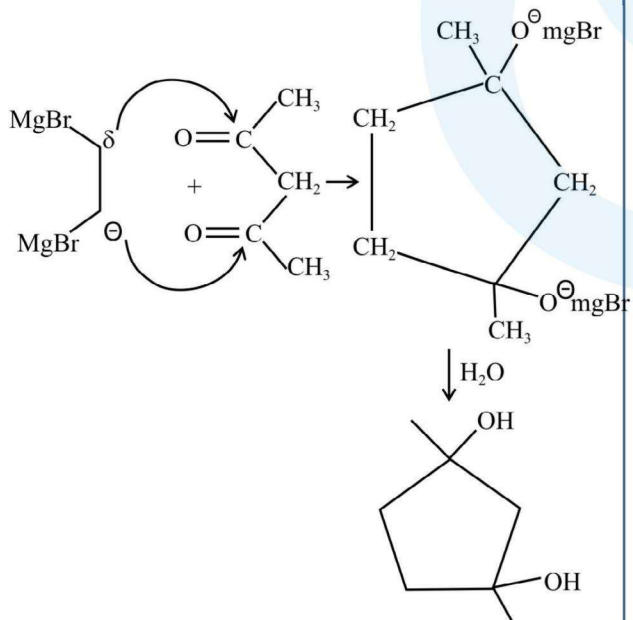
Consider the above reaction sequence and identify the product **B**.



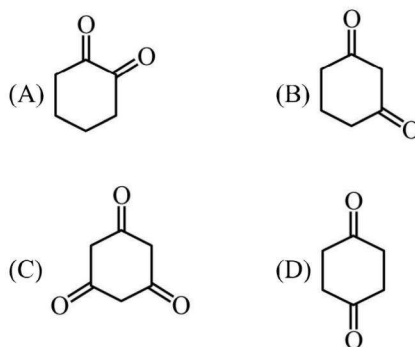
Official Ans. by NTA (A)

Ans. (A)

Sol. Although Acetyl Acetone predominantly gives Acid base reaction with G.R due to Active methylene group but according to given option ans should be based on nucleophilic addition reaction (NAR).

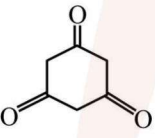
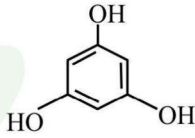


16. Which will have the highest enol content ?



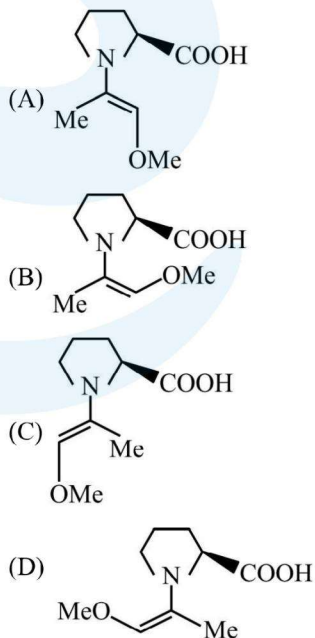
Official Ans. by NTA (C)

Ans. (C)

Sol.  is tautomer of  , Which is aromatic in nature.

17. Among the following structures, which will show the most stable enamine formation ?

(Where Me is $-\text{CH}_3$)



Official Ans. by NTA (C)

Ans. (C)

Sol. All these enamines are interconvertible through their resonating structures. So most stable form is 'C' due to steric factor.

18. Which of the following sets are **correct** regarding polymer ?

- (A) Copolymer : Buna-S
- (B) Condensation polymer : Nylon-6,6
- (C) Fibre : Nylon-6,6
- (D) Thermosetting polymer : Terylene
- (E) Homopolymer : Buna-N

Choose the **correct** answer from given options below:

- (A) (A), (B) and (C) are correct
- (B) (B), (C) and (D) are correct
- (C) (A), (C) and (E) are correct
- (D) (A), (B) and (D) are correct

Official Ans. by NTA (A)

Ans. (A,B,C)

Sol. Which of the following set are correct regarding polymer.

Bona - 5 is copolymer of butadiene + styrene

Nylon 6.6 is condensation polymer of adipic Acid and hexanediamine.

Nylon 6.6 is fiber

Terylene is fiber not themosetting polymer

Buna-N is copolymer nol Homopolymer

19. A chemical which stimulates the secretion of pepsin is :

- (A) Anti histamine (B) Cimetidine
- (C) Histamine (D) Zantac

Official Ans. by NTA (C)

Ans. (C)

Sol. Histamine (It is use for secretion of pepsin & HCl in stomach)

20. Which statement is **not** true with respect to nitrate ion test ?

(A) A dark brown ring is formed at the junction of two solutions.

(B) Ring is formed due to nitroferrous sulphate complex.

(C) The brown complex is $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]\text{SO}_4$.

(D) Heating the nitrate salt with conc. H_2SO_4 , light brown fumes are evolved.

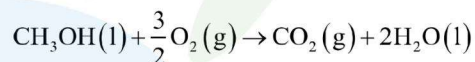
Official Ans. by NTA (B)

Ans. (B)

Sol. Ring is formed due to formation of nitrosoferrous sulphate

SECTION-B

1. For complete combustion of methanol



the amount of heat produced as measured by bomb calorimeter is 726 kJ mol^{-1} at 27°C . The enthalpy of combustion for the reaction is $-x \text{ kJ mol}^{-1}$, where x is _____. (Nearest integer)

(Given : $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$)

Official Ans. by NTA (727)

Ans. (727)

Sol. $\Delta U = -726 \text{ KJ/mol}$

$$\Delta n_g = 1 - 3/2 = \frac{-1}{2}$$

$$\Delta H = \Delta U + \Delta n_g RT$$

$$= -726 - \frac{1}{2} \times \frac{8.3 \times 300}{1000}$$

$$= -727.245$$

2. A 0.5 percent solution of potassium chloride was found to freeze at -0.24°C . The percentage dissociation of potassium chloride is _____. (Nearest integer)

(Molal depression constant for water is $1.80\text{ K kg mol}^{-1}$ and molar mass of KCl is 74.6 g mol^{-1})

Official Ans. by NTA (99 or 98)

Ans. (99 or 98)

Sol. 0.5% solution of KCl

$$m = \frac{0.5}{74.6} \times \frac{1}{0.1}$$

$$\Delta T_f = i \times m_f$$

$$0.24 = i \cdot \frac{0.5}{74.6} \times \frac{1.80}{0.1}$$

$$i = \frac{0.24 \times 74.6}{0.5 \times 1.80} \times 0.1$$

$$= 1.989$$

$$1.989 = 1 + \alpha (n-1)$$

$$1.989 = 1 + \alpha$$

$$\alpha = .989$$

$$\% \alpha = 98.9\%$$

Ans 99%

If mass of $\text{H}_2\text{O} = 99.5$

$$m = \frac{0.5}{74.5} \times \frac{1}{.0995}$$

$$i = \frac{0.24 \times 74.6 \times .0995}{.5 \times 1.80}$$

$$= 1.979$$

$$1.979 = 1 + \alpha (n-1)$$

$$1.979 = 1 + \alpha$$

$$\alpha = .979$$

$$\% \alpha = 97.9\%$$

Ans 98%

3. 50 mL of 0.1 M CH_3COOH is being titrated against 0.1 M NaOH. When 25 mL of NaOH has been added, the pH of the solution will be _____ $\times 10^{-2}$. (Nearest integer)

(Given : $\text{pK}_a (\text{CH}_3\text{COOH}) = 4.76$)

$$\log 2 = 0.30$$

$$\log 3 = 0.48$$

$$\log 5 = 0.69$$

$$\log 7 = 0.84$$

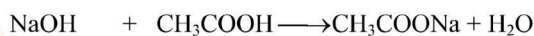
$$\log 11 = 1.04$$

Official Ans. by NTA (476)

Ans. (476)

Sol. Moles of $\text{CH}_3\text{COOH} = 5\text{ m mole}$

moles of NaOH = 2.5 m mole



2.5 m mole 2.5 m mole

0 2.5 m mole 2.5 m mole

so buffer is formed

$$\text{pH} = \text{pK}_a + \log \left(\frac{2.5/75}{2.5/75} \right) = \text{pK}_a$$

$$\text{pH} = 4.76$$

$$= 476 \times 10^{-2}$$

4. A flask is filled with equal moles of A and B. The half lives of A and B are 100 s and 50 s respectively and are independent of the initial concentration. The time required for the concentration of A to be four times that of B is _____ s.

(Given : $\ln 2 = 0.693$)

Official Ans. by NTA (200)

Ans. (200)

$$\text{Sol. } k_A = \frac{\ln 2}{100}; k_B = \frac{\ln 2}{50}$$

$$A_t = A_0 \times e^{-k_A t}$$

$$A_t = A_0 \times e^{\left(\frac{-\ln 2}{100} \times t \right)}$$

$$B_t = B_0 \times e^{\left(\frac{-\ln 2}{50} \times t \right)}$$

$$A_0 = B_0$$

$$\& A_t = 4B_t$$

$$e^{\frac{\ln 2}{100} \times t} = 4 \times e^{\frac{-\ln 2}{50} \times t}$$

$$e^{\frac{\ln 2}{100} \times t} = 4$$

$$e^{\frac{\ln 2}{100} \times t} = 4$$

$$\frac{\ln 2}{100} \times t = \ln 4 = 2 \ln 2$$

$$t = 200 \text{ sec}$$

5. 2.0 g of H₂ gas is adsorbed on 2.5 g of platinum powder at 300 K and 1 bar pressure. The volume of the gas adsorbed per gram of the adsorbent is _____ mL.

(Given : R = 0.083 L bar K⁻¹ mol⁻¹)

Official Ans. by NTA (9960)

Ans. (9960)

$$\text{Sol. Volume of H}_2 = \frac{nRT}{p} = \frac{2}{2} \times \frac{0.083 \times 300}{1}$$

$$= 24.92$$

$$= 24900 \text{ mL}$$

$$\text{So 'g platinum adsorb} = \frac{24900}{2.5} \text{ mLH}_2$$

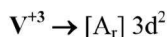
$$= 9960$$

6. The spin-only magnetic moment value of the most basic oxide of vanadium among V₂O₃, V₂O₄ and V₂O₅ is _____ B.M. (Nearest Integer)

Official Ans. by NTA (3)

Ans. (3)

Sol. Most basic oxide is V₂O₃

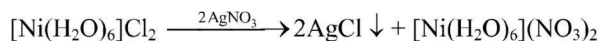
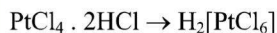
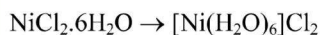
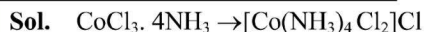


$$\mu = \sqrt{2(2+2)} = 2.84 \text{ BM} \approx 3$$

7. The spin-only magnetic moment value of an octahedral complex among CoCl₃.4NH₃, NiCl₂.6H₂O and PtCl₄.2HCl, which upon reaction with excess of AgNO₃ gives 2 moles of AgCl is _____ B.M. (Nearest Integer)

Official Ans. by NTA (3)

Ans. (3)



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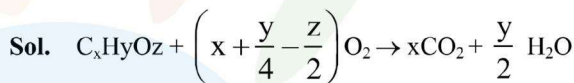
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$$\mu = \sqrt{2(2+2)} \text{ B.M} = 2.84 \text{ BM} \approx 3$$

8. On complete combustion 0.30 g of an organic compound gave 0.20 g of carbon dioxide and 0.10 g of water. The percentage of carbon in the given organic compound is _____ (Nearest Integer)

Official Ans. by NTA (18)

Ans. (18)



$$0.3\text{g} \qquad \qquad \qquad 0.2\text{g} \qquad \qquad .1\text{g}$$

$$\frac{n_{\text{CO}_2}}{n_{\text{H}_2\text{O}}} = \frac{x}{y/2} = \frac{0.2/44}{.1/18}$$

$$\frac{2x}{y} = \frac{36}{44} = \frac{9}{11}$$

$$x = \frac{9y}{22}$$

$$\frac{n_{\text{C}_x\text{H}_y\text{O}_z}}{n_{\text{CO}_2}} = \frac{1}{x}$$

$$\frac{0.3}{12x + y + 16z} \times \frac{44}{0.2} = \frac{1}{x}$$

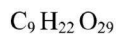
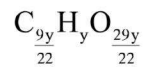
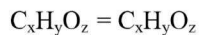
$$66x = 12x + y + 16z$$

$$54x = y + 16z$$

$$\frac{54 \times 9y}{22} - y = 16z$$

$$\frac{464y}{22} = 16z$$

$$z = \frac{29y}{22}$$



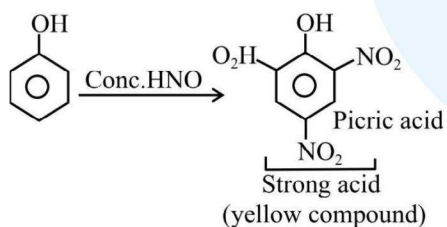
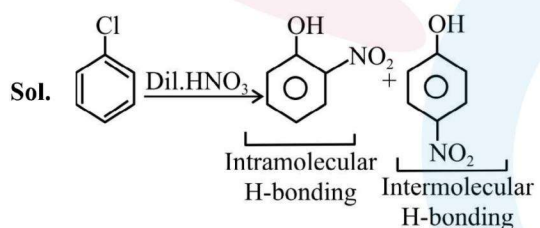
$$\% \text{ of C} = \frac{12 \times 9}{(12 \times 9 + 22 + 29 \times 16)} \times 100 = \frac{108}{594} \times 100$$

18.18%

9. Compound 'P' on nitration with dil. HNO_3 yields two isomers (A) and (B). These isomers can be separated by steam distillation. Isomers (A) and (B) show the intramolecular and intermolecular hydrogen bonding respectively. Compound (P) on reaction with conc. HNO_3 yields a yellow compound 'C', a strong acid. The number of oxygen atoms is present in compound 'C' _____.

Official Ans. by NTA (7)

Ans. (7)

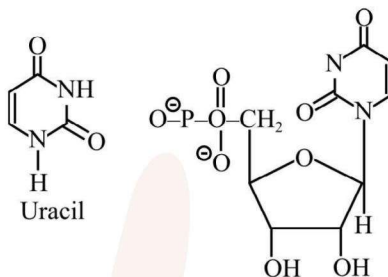


10. The number of oxygens present in a nucleotide formed from a base, that is present only in RNA is _____.

Official Ans. by NTA (9)

Ans. (9)

- Sol. Uracil is the base which only present is RNA.



Structure of nucleotides number of 0-9.