FINAL JEE–MAIN EXAMINATION – JUNE, 2022

(Held On Sunday 26th June, 2022) **TIME : 9 : 00 AM to 12 : 00 PM**

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)

Allen 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)

Allen 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 mL = 0.1 L

mass of ideal gas = 40.5 – 40 g = 0.5 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 r_3 and the radius of 4th Bohr's orbit is r_4. Then :

(A) $r_4 = \frac{9}{16}r_3$ (B) $r_4 = \frac{16}{9}r_3$

(C) $r_4 = \frac{3}{4}r_3$ (D) $r_4 = \frac{4}{3}r_3$

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. $r = 0.529\times\frac{n^2}{z}\text{ Å}$

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

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

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

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

4. Consider the ions/molecule

O_2^+, O_2, O_2^-, O_2^{2-}

For increasing bond order the correct option is :

(A) $O_2^{2-} < O_2^- < O_2 < O_2^+$

(B) $O_2^- < O_2^{2-} < O_2 < O_2^+$

(C) $O_2^- < O_2^{2-} < O_2^+ < O_2$

(D) $O_2^- < O_2^+ < O_2^{2-} < O_2$

Official Ans. by NTA (A)

Allen 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)

Allen 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)

Allen Ans. (D)

Sol. Metal oxide with lower ΔG° is more stable

Statement II is correct

8. Consider the following reaction :

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

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

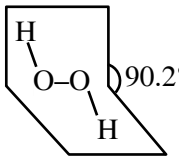
(A) 104° (B) 111.5°

(C) 90.2° (D) 111.0°

Official Ans. by NTA (C)

Allen Ans. (C)

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



90.2° Solid phase.

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)

Allen 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)

Allen Ans. (A)

Sol.

	M.P
H_2O	273 K
H_2S	188 K
H2Se	208 K
H_2Te	222 K

11. Consider the following reaction :

A + alkali $\rightarrow$ B (Major Product)

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

(A) White P_4 (B) Red P_4

(C) P_2O_3 (D) H_3PO_3

Official Ans. by NTA (B)

Allen Ans. (B)

Red P_4 + Alkali $\rightarrow$ $H_4P_2O_6$ (No P–H bond)

12. Polar stratospheric clouds facilitate the formation of :

(A) $ClONO_2$ (B) HOCl

(C) ClO (D) CH_4

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Polar stratospheric clouds provide surface on which hydrolysis of $ClONO_2$ takes place to form HOCl (Hypochlorous acid)

$ClONO_2(g) + H_2O(g) \rightarrow HOCl(g) + HNO_3(g)$

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 Na_2S.

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)

Allen Ans. (A)

Sol. Both statement I & statement II are correct.

14. $(C_7H_5O_2)_2 \xrightarrow{h\nu} [X] + 2\dot{C}_6H_5 + 2CO_2$

Consider the above reaction and identify the intermediate 'X'

(A) $C_6H_5-\overset{\overset{O}{\|}}{C}{}^{\oplus}$

(B) $C_6H_5-\overset{\overset{O}{\|}}{C}-O^{\ominus}$

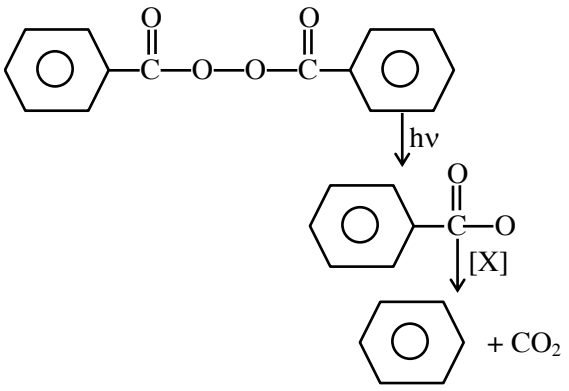
(C) $C_6H_5-\overset{\overset{O}{\|}}{C}-\ddot{O}$

(D) $C_6H_5-\overset{\overset{O}{\|}}{C}-\ddot{O}\cdot$

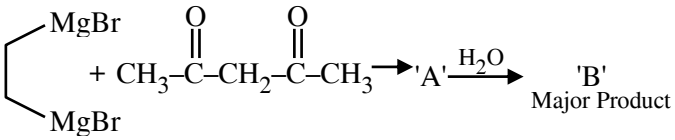
Official Ans. by NTA (D)

Allen Ans. (D)

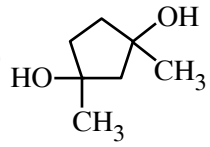
Sol.

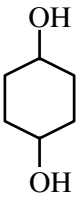


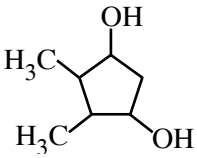
15.

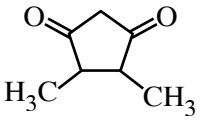


Consider the above reaction sequence and identify the product **B.**

(A) 

(B) 

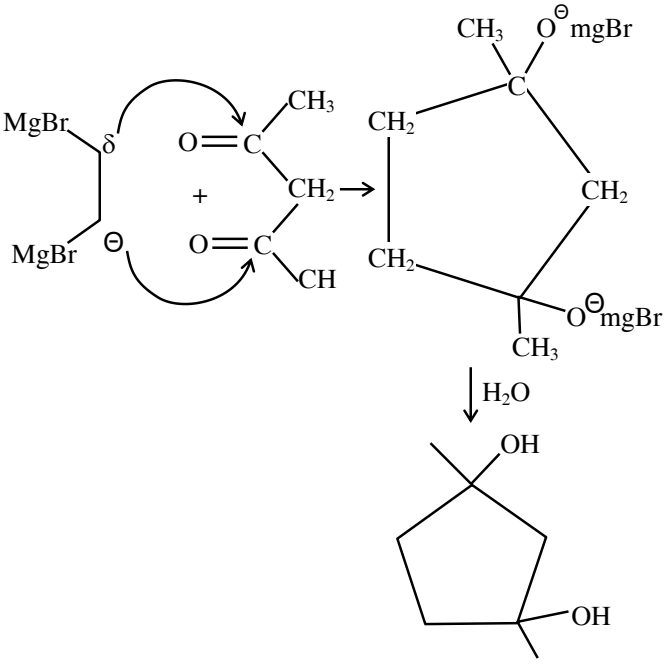
(C) 

(D) 

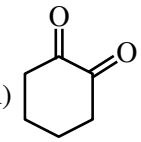
Official Ans. by NTA (A)

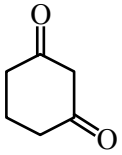
Allen Ans. (A)

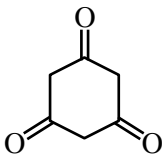
Sol. Although Acetyl Acetone predominantly gives Acid base reaction with G.R due to Active methylene group but according to given option ans should be based on nucleophilic addition reaction (NAR).

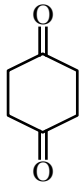


16. Which will have the highest enol content ?

(A) 

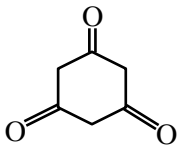
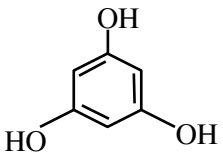
(B) 

(C) 

(D) 

Official Ans. by NTA (C)

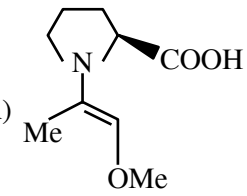
Allen Ans. (C)

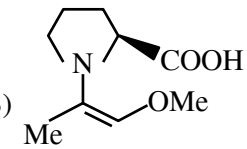
Sol.  is tautomer of 

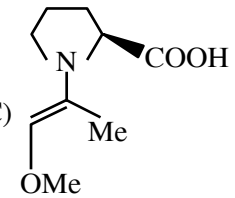
, Which is aromatic in nature.

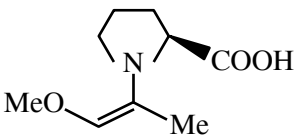
17. Among the following structures, which will show the most stable enamine formation ?

(Where Me is $-CH_3$)

(A) 

(B) 

(C) 

(D) 

Official Ans. by NTA (C)

Allen 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)

Allen 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)

Allen 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 $[Fe(H_2O)_5\ (NO)]SO_4$.

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

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Ring is formed due to formation of nitrosoferrous sulphate

SECTION–B

1. For complete combustion of methanol

$$CH_3OH(l)+\frac{3}{2}O_2(g)\rightarrow CO_2(g)+2H_2O(l)$$

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 kJ mol^{-1}, where x is _____. (Nearest integer)

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

Official Ans. by NTA (727)

Allen Ans. (727)

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

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

$\Delta H = \Delta U + \Delta ngRT$

$$=-726-\frac{1}{2}\times\frac{8.3\times300}{1000}$$

$= -727.245$

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 K kg mol^{-1} and molar mass of KCl is 74.6 g mol^{-1})

Official Ans. by NTA (98)

Allen Ans. (99 or 98)

Sol. 0.5% solution of KCl

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

$\Delta T_f = i \times m \times K_f$

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

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

$= 1.989$

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

$1.989 = 1 + \alpha$

$\alpha = .989$

$\% \ \alpha = 98.9\%$

Ans 99%

If mass of $H_2O = 99.5$

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

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

$= 1.979$

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

$1.979 = 1 + \alpha$

$\alpha = .979$

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

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 : pK_a (CH_3COOH) = 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)

Allen Ans. (476)

Sol. Moles of CH_3COOH = 5 m mole

moles of NaOH = 2.5 m mole

$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$

2.5 m mole 2.5 m mole

0 2.5 m mole 2.5 m mole

so buffer is formed

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

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)

Allen Ans. (200)

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 sec

5. 2.0 g of H_2 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)

Allen Ans. (9960)

Sol. Volume of $H_2 = \frac{nRT}{p} = \frac{2}{2}\times\frac{0.083\times 300}{1}$

= 24.92 L

= 24900 mL

So 1 g platinum adsorb $= \frac{24900}{2.5}\text{mL}H_2$

= 9960

6. The spin–only magnetic moment value of the most basic oxide of vanadium among V_2O_3, V_2O_4 and V_2O_5 is _____ B.M. (Nearest Integer)

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Most basic oxide is V_2O_3

$V^{+3} \rightarrow [A_r]\ 3d^2$

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

7. The spin–only magnetic moment value of an octahedral complex among $CoCl_3.4NH_3$, $NiCl_2.6H_2O$ and $PtCl_4.2HCl$, which upon reaction with excess of $AgNO_3$ gives 2 moles of AgCl is _____ B.M. (Nearest Integer)

Official Ans. by NTA (3)

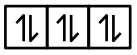
Allen Ans. (3)

Sol. $CoCl_3.4NH_3 \rightarrow [Co(NH_3)_4Cl_2]Cl$

$NiCl_2.6H_2O \rightarrow [Ni(H_2O)_6]Cl_2$

$PtCl_4 . 2HCl \rightarrow H_2[PtCl_6]$

$[Ni(H_2O)_6]Cl_2 \xrightarrow{2AgNO_3} 2AgCl\downarrow + [Ni(H_2O)_6](NO_3)_2$



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

Allen Ans. (18)

Sol. $C_xHyOz + \left(x+\frac{y}{4}-\frac{z}{2}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}\ H_2O$

0.3g 0.2g .1g

$\frac{n_{CO_2}}{n_{H_2O}} = \frac{x}{y/2} = \frac{0.2/44}{.1/18}$

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

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

$\frac{n_{C_xH_yO_z}}{n_{CO_2}} = \frac{1}{x}$

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

66x = 12 x + y + 16 z

54x = y + 16 z

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

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

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

$C_xH_yO_z = C_xH_yO_z$

$C_{\frac{9y}{22}}H_yO_{\frac{29y}{22}}$

$C_9H_{22}O_{29}$

$$\% \text{ of C} = \frac{12\times9}{(12\times9+22+29\times16)}\times100 = \frac{108}{594}\times100$$

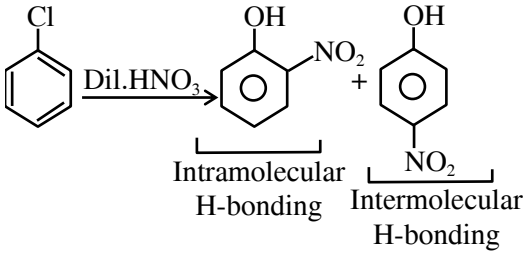
18.18%

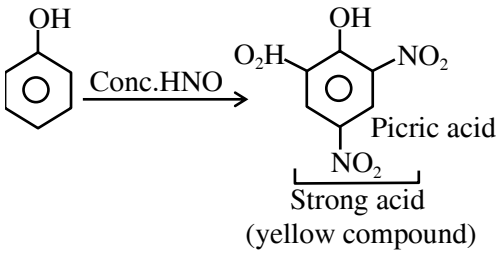
9. Compound 'P' on nitration with dil. HNO_3 yields two isomers (A) and (B). These isomers can be separated by steam distillation. Isomers (A) and (B) show the intramolecular and intermolecular hydrogen bonding respectively. Compound (P) on reaction with conc. HNO_3 yields a yellow compound 'C', a strong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

Official Ans. by NTA (7)

Allen Ans. (7)

Sol.



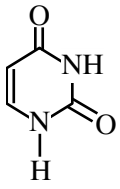


10. The number of oxygens present in a nucleotide formed from a base, that is present only in RNA is _____.

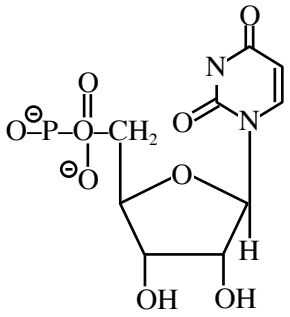
Official Ans. by NTA (9)

Allen Ans. (9)

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



Uracil



Structure of nucleotides number of 0-9.