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JEE (ADVANCED) 2023

QUESTIONS & TEXT SOLUTION

PAPER-2

DATE & DAY: 4th JUNE 2023, SUNDAY

PAPER-1	PAPER-2
Duration: 3 Hrs.	**Duration:** 3 Hrs.
Time: 09:00 - 12:00 IST	**Time:** 14:30 - 17:30 IST

SUBJECT: CHEMISTRY

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
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TARGET: JEE (Adv.) 2024

VIJAY COURSE

For 12th Passed Students

Course Features*

- Course Duration: **32 Weeks**
- Total No. of Lectures: **533** (P: 178 | C: 177 | M: 178)
- Duration of One Lecture: **1.5 Hrs.** (90 Minutes)
- Classroom Teaching Hours.: **800 Hrs.**
- Testing Duration: **60 Hrs.**
- Total Academic Hours.: **860 Hrs.**

CLASS STARTS
5th & 19th June

AIR 6
JEE (Adv.) 2022
KARTHIKEYA P.

SCHOLARSHIP UPTO 100%
Based on JEE (Advanced) 2023 Score, Scholarship Test (ResoNET) & 12th Board

TARGET: JEE (Main) 2024

AIR 5
JEE (Main) 2023
KAUSHAL V.

AJAY COURSE

For 12th Passed Students

Course Features*

- Course Duration: **33 Weeks**
- Total No. of Lectures: **571** (P:1 84 | C: 203 | M: 184)
- Duration of One Lecture: **1.5 Hrs.** (90 Minutes)
- Classroom Teaching Hours.: **857 Hrs.**
- Testing Duration: **33 Hrs.**
- Total Academic Hours.: **890 Hrs.**

CLASS STARTS
5th & 19th June

SCHOLARSHIP UPTO 100%
Based on JEE (Main) 2023 Score, Scholarship Test (ResoNET) & 12th Board

PART : CHEMISTRY

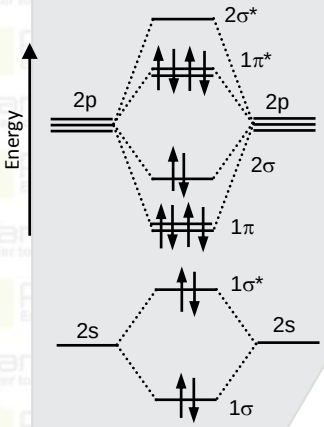
SECTION 1 : 12 Marks

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:

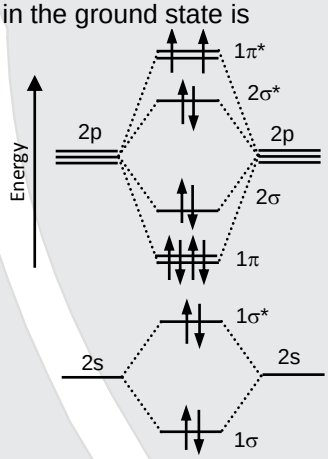
Full Marks : **+3** If **ONLY** the correct option is chosen;
Zero Marks : **0** If none of the options is chosen (i.e. the question is unanswered);
Negative Marks : **−1** In all other cases.

1. The correct molecular orbital diagram for F_2 molecule in the ground state is

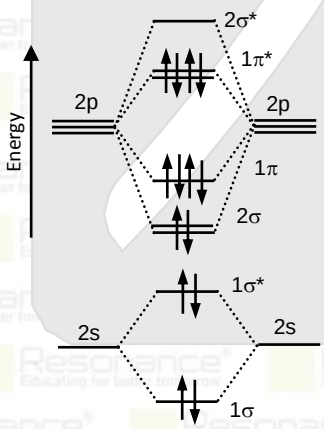
(A)



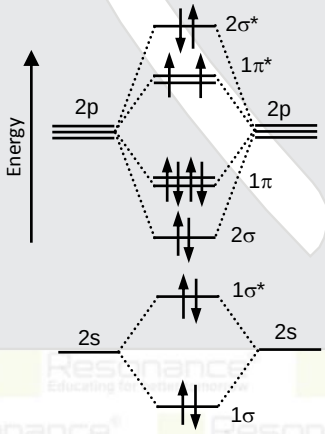
(B)



(C)



(D)



Ans. **(C)**

Sol. $\sigma_{1s}^2 < \sigma^*_{1s}{}^2 < \sigma_{2s}^2 < \sigma^*_{2s}{}^2 < \sigma_{2pz}^2 < \pi 2p_x^2 \equiv \pi 2p_y^2 < \pi^* 2p_x^2 = \pi^* 2p_z^2$

2. Consider the following statements related to colloids.

(I) Lyophobic colloids are **not** formed by simple mixing of dispersed phase and dispersion medium.

(II) For emulsions, both the dispersed phase and the dispersion medium are liquid.

(III) Micelles are produced by dissolving a surfactant in any solvent at any temperature.

(IV) Tyndall effect can be observed from a colloidal solution with dispersed phase having the same refractive index as that of the dispersion medium.

The option with the correct set of statements is

(A) (I) and (II) (B) (II) and (III)

(C) (III) and (IV) (D) (II) and (IV)

Ans. **(A)**

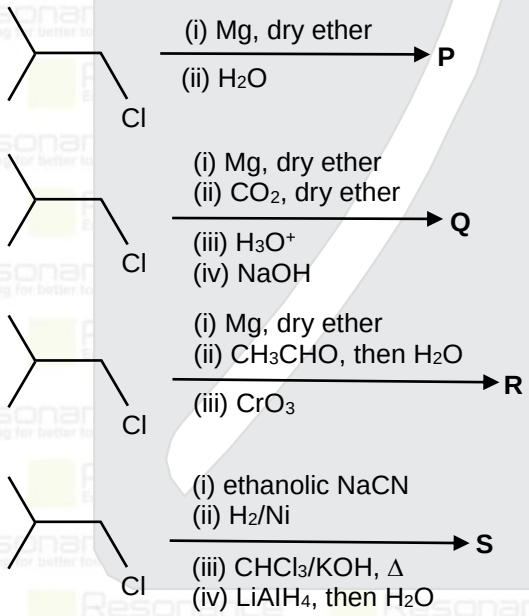
Sol. ⟶ Lyophobic solution are prepared by special methods not just by mixing of dispersed Phase & Dispersion mediam

⟶ emulsion is made by Immiscible liquids

⟶ Micelle formation takes place above a particular temperature named as kraft temperature

⟶ If Dispersed Phase & dispersion median have same refractive index then there will be no scattering of light & No tyndall effect will be observe.

3. In the following reactions, **P**, **Q**, **R**, and **S** are the major products.



The correct statement about **P**, **Q**, **R**, and **S** is

(A) **P** is a primary alcohol with four carbons.

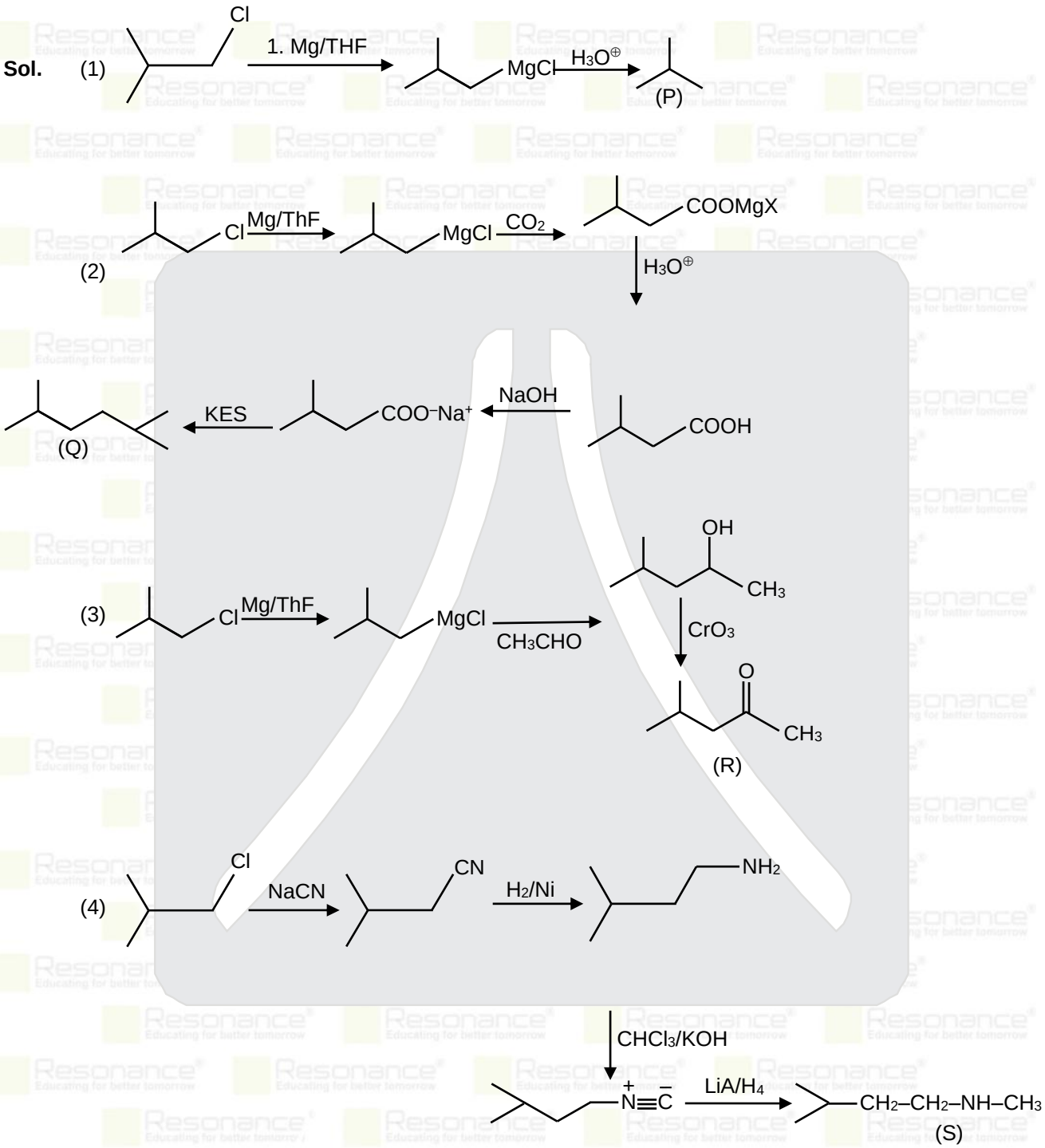
(B) **Q** undergoes Kolbe's electrolysis to give an eight-carbon product.

(C) **R** has six carbons and it undergoes Cannizzaro reaction.

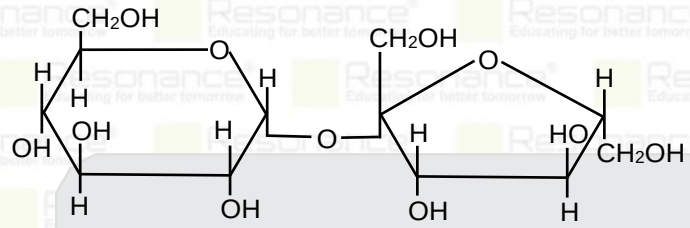
(D) **S** is a primary amine with six carbons.

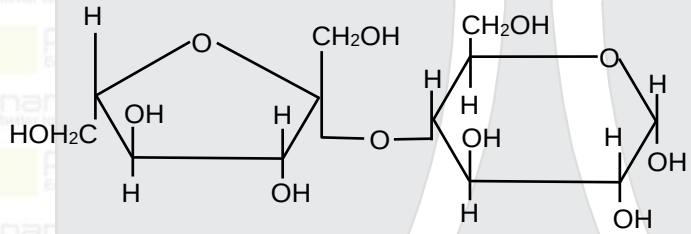
Ans. **(B)**

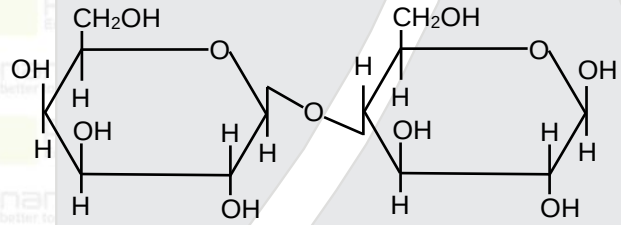
Sol.

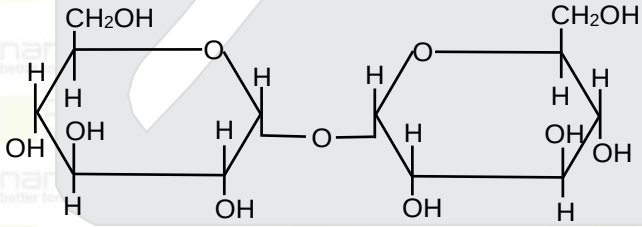

(1)
Cl
1. Mg/THF
MgCl
$H_3O^{\oplus}$
(P)
(2)
Cl
Mg/ThF
MgCl
CO_2
COOMgX
$H_3O^{\oplus}$
(Q)
KES
COO^-Na^+
NaOH
COOH
(3)
Cl
Mg/ThF
MgCl
CH_3CHO
OH
CH_3
CrO_3
O
CH_3
(R)
(4)
Cl
NaCN
CN
H_2/Ni
NH_2
$CHCl_3/KOH$
$\overset{+}{N}\equiv\overset{-}{C}$
LiA/H_4
$CH_2–CH_2–NH–CH_3$
(S)

4. A disaccharide **X** cannot be oxidised by bromine water. The acid hydrolysis of **X** leads to a laevorotatory solution. The disaccharide **X** is

(A) 

(B) 

(C) 

(D) 

Ans. **(A)**

Sol. disaccharide X will be sucrose which is non reducing sugar & on acid hydrolysis a solution of glucose & fructose which is a laevorotatory solution.

SECTION 2 : 12 Marks

- This section contains **THREE (03)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : **+4** If only (all) the correct option(s) is(are) chosen;
Partial Marks : **+3** If all the four options are correct but **ONLY** three options are chosen;
Partial Marks : **+2** If three or more options are correct but **ONLY** two options are chosen, both of which are correct;
Partial Marks : **+1** If two or more options are correct but **ONLY** one option is chosen and it is a correct option;
Zero Marks : **0** If unanswered;
Negative Marks : **−2** In all other cases.

- For example, in a question, if (A), (B) and (D) are the **ONLY** three options corresponding to correct answers, then
choosing ONLY (A), (B) and (D) will get +4 marks;
choosing ONLY (A) and (B) will get +2 marks;
choosing ONLY (A) and (D) will get +2marks;
choosing ONLY (B) and (D) will get +2 marks;
choosing ONLY (A) will get +1 mark;
choosing ONLY (B) will get +1 mark;
choosing ONLY (D) will get +1 mark;
choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
choosing any other option(s) will get −2 marks.

---

5. The complex(es), which can exhibit the type of isomerism shown by $[Pt(NH_3)_2Br_2]$, is(are)
[en = $H_2NCH_2CH_2NH_2$]
(A) $[Pt(en)(SCN)_2]$ (B) $[Zn(NH_3)_2Cl_2]$
(C) $[Pt(NH_3)_2Cl_4]$ (D) $[Cr(en)_2(H_2O)(SO_4)]^+$

Ans. **(CD)**

Sol. $[Pt(NH_3)_2Br_2]$ exhibits cis-trans isomerism (Geometric isomerism)
(B) $[M(AA)_2ab]$ & $[Ma_2b_4]$ can exhibit geometric isomerism.

6. Atoms of metals x, y, and z form face-centred cubic (fcc) unit cell of edge length L_x, body-centred cubic (bcc) unit cell of edge length L_y, and simple cubic unit cell of edge length L_z, respectively.

If $r_z = \frac{\sqrt{3}}{2} r_y$; $r_y = \frac{8}{\sqrt{3}} r_x$; $M_z = \frac{3}{2} M_y$ and $M_z = 3M_x$, then the correct statement(s) is(are)

[Given: M_x, M_y, and M_z are molar masses of metals x, y, and z, respectively. r_x, r_y, and r_z are atomic radii of metals x, y, and z, respectively.]

(A) Packing efficiency of unit cell of x > Packing efficiency of unit cell of y > Packing efficiency of unit cell of z
(B) $L_y > L_z$
(C) $L_x > L_y$
(D) Density of x > Density of y

Ans. **(ABD)**

Sol. Packing efficiency

FCC $PE = \frac{4\times 4/3\pi r_x^3}{(L_x)^3} = \frac{4\times 4/3\pi r_x^3}{\left(\frac{4rx}{\sqrt{2}}\right)^3}$

BCC $PE = \frac{2\times 4/3\pi r_y^3}{(L_y)^3} = \frac{2\times 4/3\pi r_y^3}{\left(\frac{4r_y}{\sqrt{3}}\right)^3}$

S.C. $PE = \frac{1\times 4/3\pi r_z^3}{(L_z)^3} = \frac{1\times 4/3\pi r_z^3}{(2r_z)^3}$

PE FCC : BCC : SC

$= \frac{4\times(\sqrt{2})^3}{(4)^3} : \frac{4\times(\sqrt{3})^3}{(4)^3} : \frac{1}{(2)^3}$

$= \frac{2\sqrt{2}}{16} : \frac{2\times 3\times\sqrt{3}}{16} : \frac{1}{8}$

$= 8\sqrt{2} : 6\sqrt{3} : 8$

$= 11.3 : 10.392 : 8$

$L_x = \frac{4r_x}{\sqrt{2}}$, $L_y = \frac{4r_y}{\sqrt{3}}$, $L_z = 2r_z$

$L_x < L_y$

$\frac{L_x}{L_y} = \frac{r_x}{r_y}\cdot\frac{\sqrt{3}}{\sqrt{2}} = \frac{\sqrt{3}}{8}\times\frac{\sqrt{3}}{\sqrt{2}} = \frac{3}{8\sqrt{2}}$

$L_y = \frac{4r_y}{\sqrt{3}}$, $L_z = 2r_z$

$\frac{L_y}{L_z} = \frac{2r_y}{r_z.\sqrt{3}} = \frac{2}{\sqrt{3}}\times\frac{2}{\sqrt{3}} = \frac{4}{3}$ $L_y > L_z$

$(\text{Density})_\alpha = \frac{4M_x}{N_A(L_x)^3}$, $(\text{Density})_y = \frac{2M_y}{N_A(L_y)^3}$

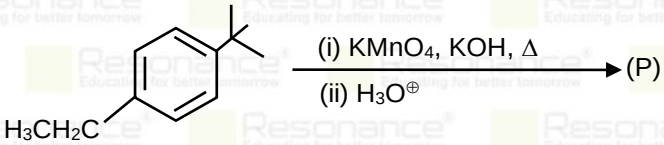
$\frac{d_x}{d_y} = \frac{2M_x}{M_y}\cdot\left(\frac{L_y}{L_x}\right)^3$

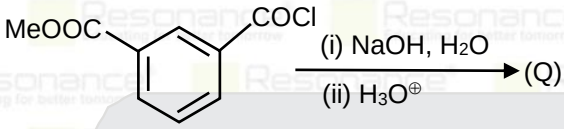
$= 2\times\frac{1}{2}\times\left(\frac{8\sqrt{2}}{3}\right)^3$

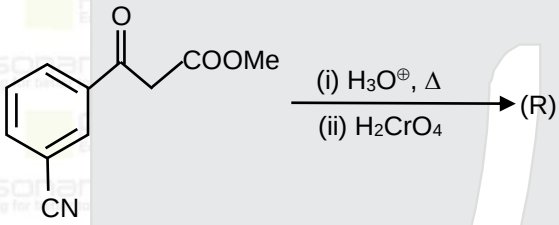
SO: $d_x > d_y$

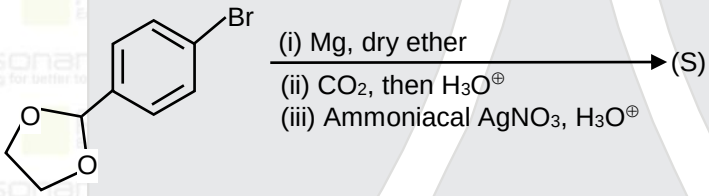
Ans. **(ABD)**

7. In the following reactions, **P**, **Q**, **R**, and **S** are the major products.









The correct statement(s) about **P**, **Q**, **R**, and **S** is(are)

(A) **P** and **Q** are monomers of polymers dacron and glyptal, respectively

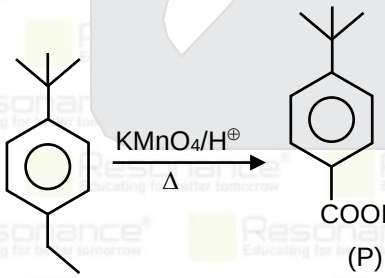
(B) **P**, **Q**, and **R** are dicarboxylic acids

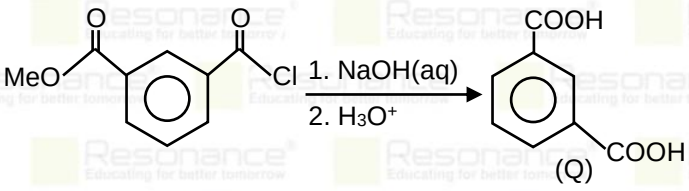
(C) Compounds **Q** and **R** are the same.

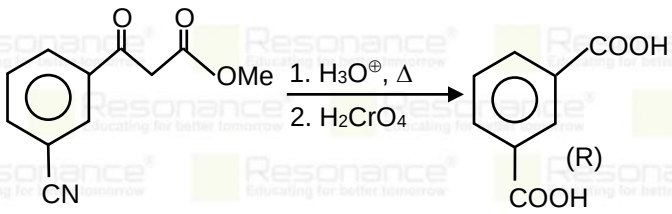
(D) **R** does **not** undergo aldol condensation and **S** does **not** undergo Cannizzaro reaction.

Ans. **(CD)**

Sol.







SECTION-3 : 24 Marks

- This section contains **SIX (06)** questions.
- The answer to each question is a **NON-NEGATIVE INTEGER**.
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:
  Full Marks : **+4 ONLY** if the correct numerical value is entered;
  Zero Marks : **0** In all other cases.

8. H_2S (5 moles) reacts completely with acidified aqueous potassium permanganate solution. In this reaction, the number of moles of water produced is **x**, and the number of moles of electrons involved is **y**. The value of (**x** + **y**) is ____.

Ans. **(18)**

Sol. $2KMnO_4 + 3H_2SO_4 + 5H_2S \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5S$

X = 8

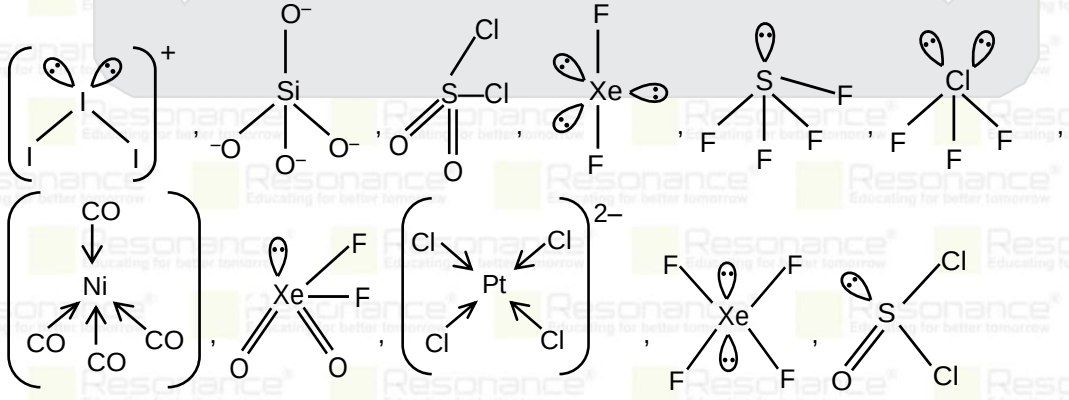
Y = 10

9. Among $[I_3]^+$, $[SiO_4]^{4-}$, SO_2Cl_2, XeF_2, SF_4, ClF_3, $Ni(CO)_4$, XeO_2F_2, $[PtCl_4]^{2-}$, XeF_4, and $SOCl_2$, the total number of species having sp^3 hybridised central atom is _____.

Ans. **(5)**

$[I_3]^+$, $[SiO_4]^{-4}$, SO_2Cl_2, $[Ni(CO)_4]$, $SOCl_2$

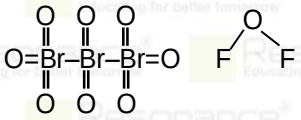
Sol.

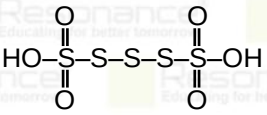


10. Consider the following molecules: Br_3O_8, F_2O, $H_2S_4O_6$, $H_2S_5O_6$, and C_3O_2. Count the number of atoms existing in their zero oxidation state in each molecule. Their sum is____.

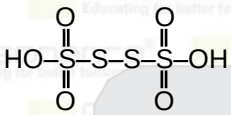
Ans. **(6)**

Sol.

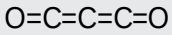




3 Sulphur



2 Sulphur



1 Carbon

11. For He^+, a transition takes place from the orbit of radius 105.8 pm to the orbit of radius 26.45 pm. The wavelength (in nm) of the emitted photon during the transition is ___.

[**Use:**
Bohr radius, a = 52.9 pm
Rydberg constant, $R_H = 2.2 \times 10^{-18}$ J
Planck's constant, $h = 6.6 \times 10^{-34}$ J s
Speed of light, $c = 3 \times 10^8$ m s^{-1}]

Ans. **(30 nm)**

Sol. $$\frac{1}{\lambda} = \frac{R_H Z^2}{h.c}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{\lambda} = \frac{2.2\times10^{-18}\times Z^2}{6.6\times10^{-34}\times3\times10^{8}}\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$\Rightarrow \frac{2.2\times10^{-18}\times4}{6.6\times3\times10^{-26}} \times \frac{3}{4}$$

$$\lambda = \frac{6.6\times3\times10^{-26}}{2.2\times3\times10^{-18}}$$

$\Rightarrow 3 \times 10^{-8} \Rightarrow 30 \times 10^{-9}$
= 30 nm

12. 50 mL of 0.2 molal urea solution (density = 1.012 g mL^{-1} at 300 K) is mixed with 250 mL of a solution containing 0.06 g of urea. Both the solutions were prepared in the same solvent. The osmotic pressure (in Torr) of the resulting solution at 300 K is ___.
[Use: Molar mass of urea = 60 g mol-1; gas constant, R = 62 L Torr K^{-1} mol^{-1} ;
Assume, $\Delta_{mix}H = 0$, $\Delta_{mix}V = 0$]

Ans. **(682)**

Sol. Mass of solution = 50 ml × 1.012 = 50.6 g = xg urea + (50.6 – x)g H_2O

$$\text{molality} = 0.2 = \frac{\frac{x}{60}}{\frac{50.6-x}{1000}} \qquad x = 0.6 \text{ g urea} \equiv 0.01 \text{ mol urea}$$

Other solution has 0.06 g urea ≡ 0.001 mol urea

$$\pi_{resulting} = \frac{(0.01+0.001)}{0.3} \times 62 \times 300 = 682 \text{ torr}$$

13. The reaction of 4-methyloct-1-ene (**P**, 2.52 g) with HBr in the presence of $(C_6H_5CO)_2O_2$ gives two isomeric bromides in a 9 : 1 ratio, with a combined yield of 50%. Of these, the entire amount of the primary alkyl bromide was reacted with an appropriate amount of diethylamine followed by treatment with aq. K_2CO_3 to give a non-ionic product **S** in 100% yield.

The mass (in mg) of **S** obtained is ___.

[Use molar mass (in g mol^{-1}): H = 1, C = 12, N = 14, Br = 80]

Ans. **(129.6 mg)**

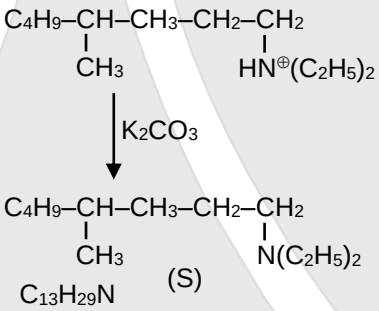
Sol. 4-Methyloct-1-ene $\xrightarrow[50\%]{HBr\ /\ Peroxide}$ 1-Bromo-4-methyloctane + 2-Bromo-4-methyloctane

M.M. = 126 mole = 0.01 (9 : 1) $\rightarrow$ given

Given mass = 2.52 gm Final mole = 0.009

$$\text{moles} = \frac{2.56}{126} = 0.02 \text{ mole}$$

1-Bromo-4-methyloctane $\xrightarrow[aq.K_2CO_3]{Diethyla\ min\ e}$



MW of S = 199, weight of S in mg = 0.009 × 199 = 1791

SECTION-4 : 12 Marks

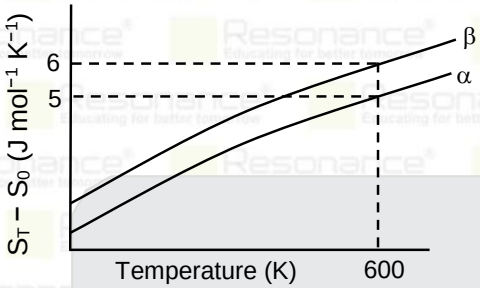
- This section contains **TWO (02)** question paragraphs.
- Based on each paragraph, there are **TWO (02)** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : **+3** If **ONLY** the correct numerical value is entered at the designated place;

  Zero Marks : **0** In all other cases

PARAGRAPH I

The entropy versus temperature plot for phases α and β at 1 bar pressure is given.
S_T and S_0 are entropies of the phases at temperatures T and 0 K, respectively



The transition temperature for α to β phase change is 600 K and $C_{p,\beta} - C_{p,\alpha}$ = 1J mol^{-1} K^{-1}. Assume $(C_{p,B} - C_{p,\alpha})$ is independent of temperature in the range of 200 to 700K. $C_{p,\alpha}$ and $C_{p,\beta}$ are heat capacities of α and β phases, respectively.

14. The value of entropy change, $S_\beta - S_\alpha$ (in J mol^{-1} K^{-1}), at 300 K is ___.
[Use: ln 2 = 0.69
Given: $S_\beta - S_\alpha = 0$ at 0 K]

Ans. **(0.30)**

Sol. For α $S_{600,\alpha} - S_{300,\alpha} = \int_{300}^{600} \frac{C_{p,\alpha}\, dT}{T}$

$= C_{p,\alpha}\, \ell n \frac{600}{300}$

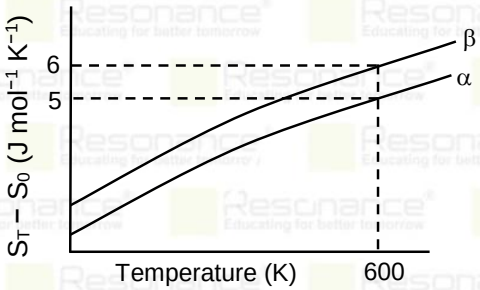
For β $S_{600,\beta} - S_{300,\beta} = \int_{300}^{600} \frac{C_{p,\beta}\, dT}{T}$

$= C_{p,\beta}\, \ell n \frac{600}{300}$

$(S_{600,\beta} - S_{600,\alpha}) - (S_{300,\beta} - S_{300,\alpha}) = (C_{p,\beta} - C_{p,\alpha})\ell n2$
$(6 - 5) - (S_{300,\beta} - S_{300,\alpha}) = 1 \times 0.693$
$S_{300,\beta} - S_{300,\alpha} = 1 - 0.693 = +.307 = 0.30$ Ans

PARAGRAPH I

The entropy versus temperature plot for phases α and β at 1 bar pressure is given.
S_T and S_0 are entropies of the phases at temperatures T and 0 K, respectively



The transition temperature for α to β phase change is 600 K and $C_{p,\beta} - C_{p,\alpha}$ = 1J mol^{-1} K^{-1}. Assume $(C_{p,B} - C_{p,\alpha})$ is independent of temperature in the range of 200 to 700K. $C_{p,\alpha}$ and $C_{p,\beta}$ are heat capacities of α and β phases, respectively.

15. The value of enthalpy change, $H_\beta - H_\alpha$ (in J mol^{-1}), at 300 K is ___.

Ans. **(300)**

Sol. $\Delta H_{600} - \Delta H_{300} = (C_{p,\beta} - C_{p,\alpha})\ (600 - 300)$

$T\Delta S_{600} = \Delta H_{600}$ (at transition state)

$\Delta H_{600} \Rightarrow 600$ J/mol

$600 - \Delta H_{300} = 300$

$\Delta H_{300} = 300$ J/mol Ans.

PARAGRAPH II

A trinitro compound, 1,3,5-tris-(4-nitrophenyl)benzene, on complete reaction with an excess of Sn/HCl gives a major product, which on treatment with an excess of $NaNO_2$/HCl at 0 °C provides **P** as the product. **P**, upon treatment with excess of H_2O at room temperature, gives the product **Q**. Bromination of **Q** in aqueous medium furnishes the product **R**. The compound **P** upon treatment with an excess of phenol under basic conditions gives the product **S**.

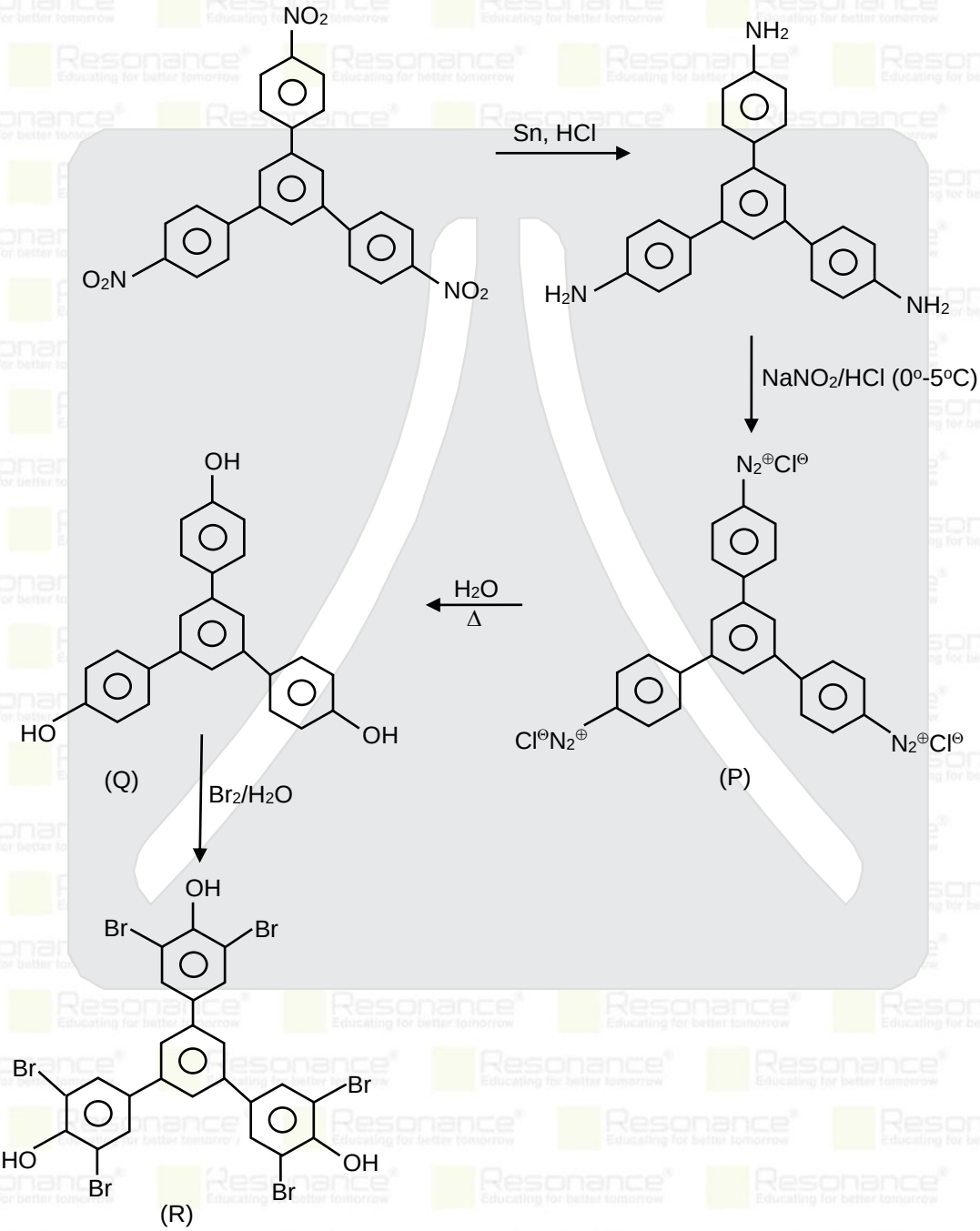
The molar mass difference between compounds **Q** and **R** is 474 g mol^{-1} and between compounds **P** and **S** is 172.5 g mol^{-1}.

16. The number of heteroatoms present in one molecule of **R** is _____ .

[Use: Molar mass (in g mol^{-1}): H = 1, C = 12, N = 14, O = 16, Br = 80, Cl = 35.5 Atoms other than C and H are considered as heteroatoms]

Ans. **9**

Sol.


NO2
O2N
NO2
Sn, HCl
NH2
H2N
NH2
NaNO2/HCl (0°-5°C)
N2⊕Cl⊖
Cl⊖N2⊕
N2⊕Cl⊖
(P)
H2O
Δ
OH
HO
OH
(Q)
Br2/H2O
OH
Br
Br
Br
Br
HO
Br
OH
Br
(R)

PARAGRAPH II

A trinitro compound, 1,3,5-tris-(4-nitrophenyl)benzene, on complete reaction with an excess of Sn/HCl gives a major product, which on treatment with an excess of $NaNO_2$/HCl at 0 °C provides **P** as the product. **P**, upon treatment with excess of H_2O at room temperature, gives the product **Q**. Bromination of **Q** in aqueous medium furnishes the product **R**. The compound **P** upon treatment with an excess of phenol under basic conditions gives the product **S**.

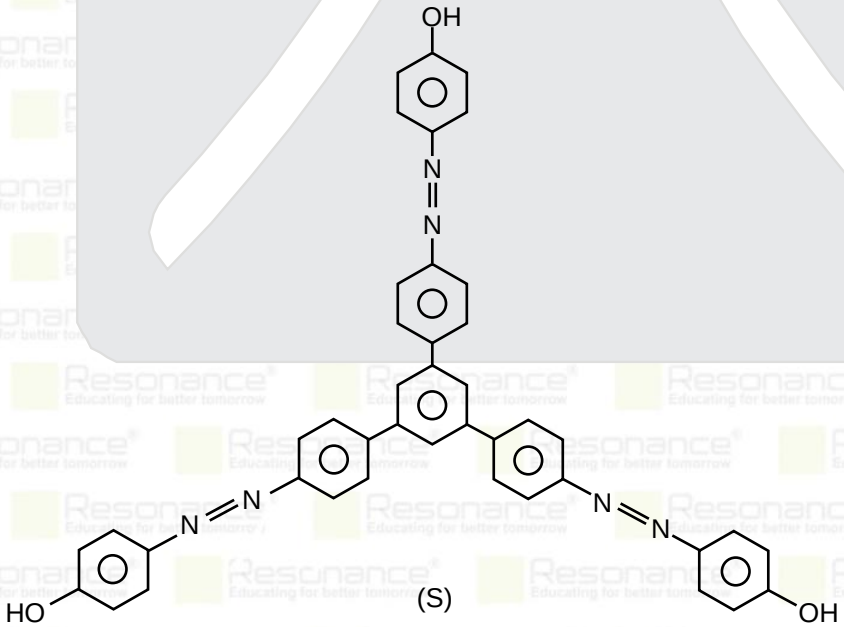
The molar mass difference between compounds **Q** and **R** is 474 g mol^{-1} and between compounds **P** and **S** is 172.5 g mol^{-1}.

17. The total number of carbon atoms and heteroatoms present in one molecule of **S** is _____ .

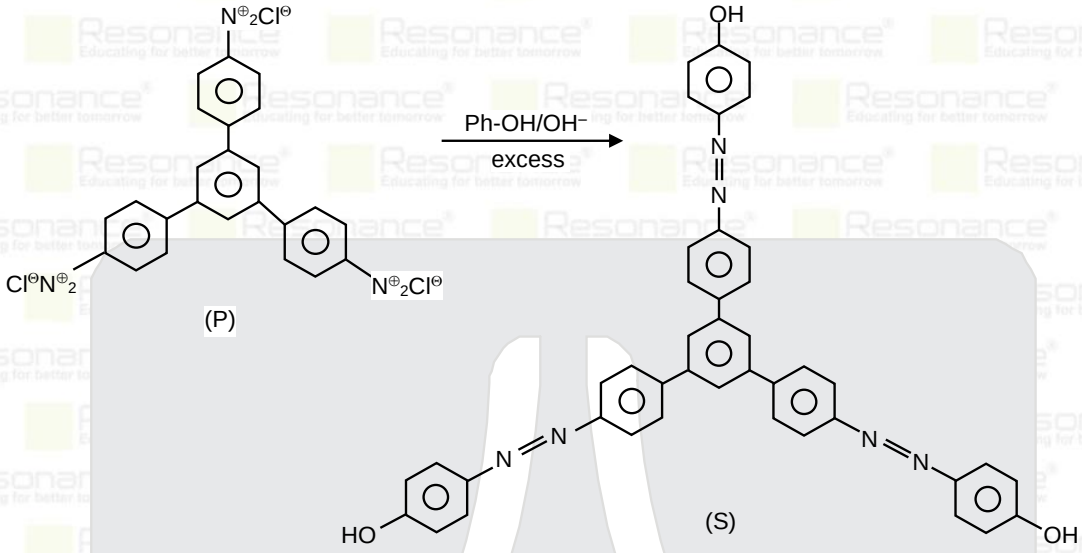
[Use: Molar mass (in g mol^{-1}): H = 1, C = 12, N = 14, O = 16, Br = 80, Cl = 35.5 Atoms other than C and H are considered as heteroatoms]

Ans. **51**

Sol.



(S)


N⊕2Cl⊖
Ph-OH/OH⁻
excess
OH
N
N
Cl⊖N⊕2
N⊕2Cl⊖
(P)
HO
N
N
N
N
(S)
OH

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