

## FINAL JEE(Advanced) EXAMINATION – 2023

 (Held On Sunday 04<sup>th</sup> June, 2023)

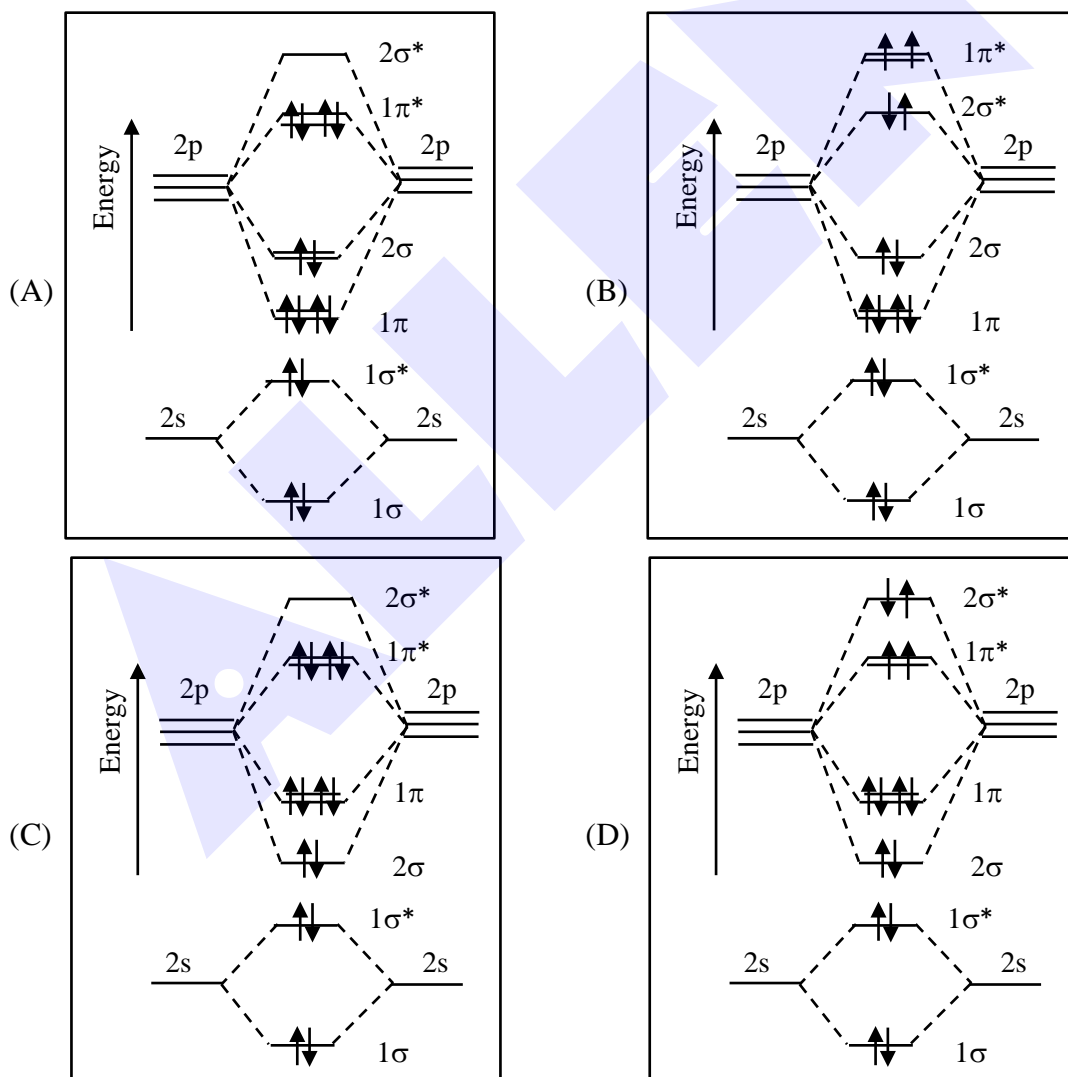
PAPER-2

TEST PAPER WITH ANSWER

**CHEMISTRY**
**SECTION-1 : (Maximum Marks : 12)**

- 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



Ans. (C)

2. Consider the following statements related to colloids.

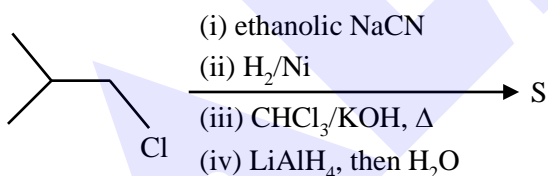
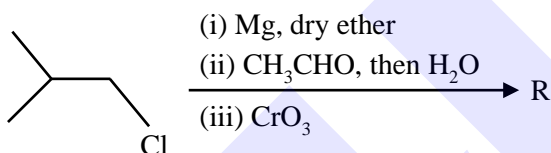
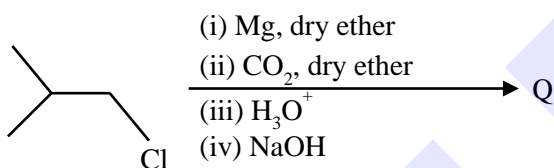
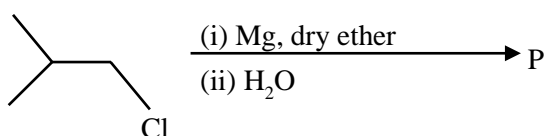
- (I) Lyophobic colloids are **not** formed by simple mixing of dispersed phase and dispersion medium.
- (II) For emulsions, both the dispersed phase and the dispersion medium are liquid.
- (III) Micelles are produced by dissolving a surfactant in any solvent at any temperature.
- (IV) Tyndall effect 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)

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

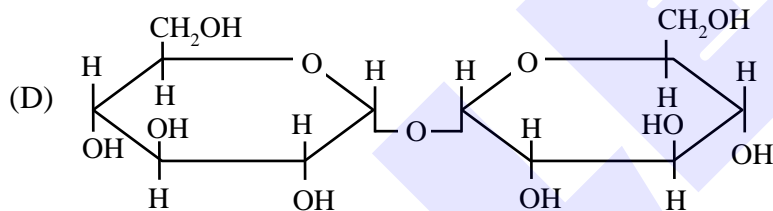
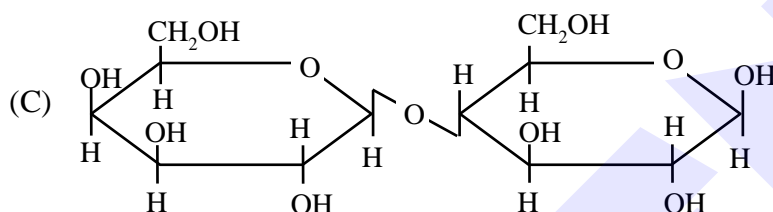
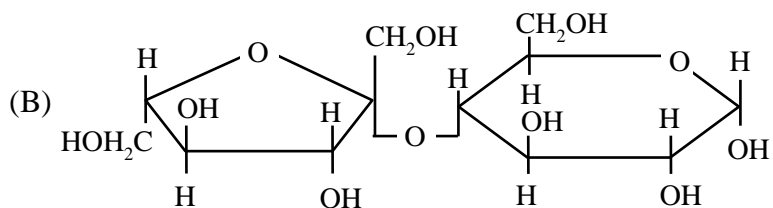
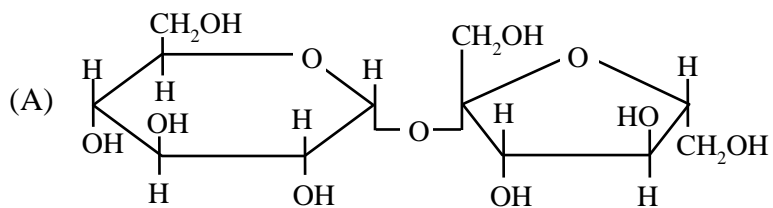


The correct statement about **P**, **Q**, **R**, and **S** is

- (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)

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



Ans. (A)

**SECTION-2 : (Maximum Marks : 12)**

- 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:
 

<i>Full Marks</i>	: +4	<b>ONLY</b> if (all) the correct option(s) is(are) chosen;
<i>Partial Marks</i>	: +3	If all the four options are correct but <b>ONLY</b> three options are chosen;
<i>Partial Marks</i>	: +2	If three or more options are correct but <b>ONLY</b> two options are chosen, both of which are correct;
<i>Partial Marks</i>	: +1	If two or more options are correct but <b>ONLY</b> one option is chosen and it is a correct option;
<i>Zero Marks</i>	: 0	If unanswered;
<i>Negative Marks</i>	: -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 +2 marks;
  - 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  $[\text{Pt}(\text{NH}_3)_2\text{Br}_2]$ , is(are)  $[\text{en} = \text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2]$
- (A)  $[\text{Pt}(\text{en})(\text{SCN})_2]$     (B)  $[\text{Zn}(\text{NH}_3)_2\text{Cl}_2]$     (C)  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_4]$     (D)  $[\text{Cr}(\text{en})_2(\text{H}_2\text{O})(\text{SO}_4)]^+$

Ans. (C,D)

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)

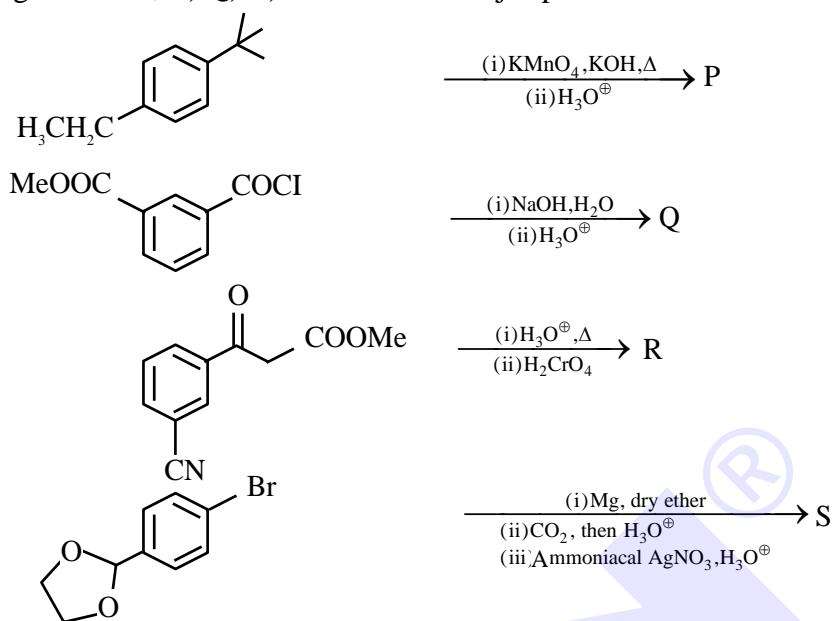
[Given :  $M_x$ ,  $M_y$ , and  $M_z$  are molar masses of metals x, y, and z, respectively.

$r_x$ ,  $r_y$ , 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. (A,B,D)

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. (C,D)

### SECTION-3 : (Maximum Marks : 24)

- This section contains **SIX (06)** questions.
- The answer to each question is a **NON-NEGATIVE INTEGER**.
- For each question, enter the correct integer corresponding to 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 according to the following marking scheme:  
*Full Marks* : +4 If **ONLY** the correct integer is entered;  
*Zero Marks* : 0 In all other cases

8.  $\text{H}_2\text{S}$  (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)

9. Among  $[\text{I}_3]^+$ ,  $[\text{SiO}_4]^{4-}$ ,  $\text{SO}_2\text{Cl}_2$ ,  $\text{XeF}_2$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{Ni}(\text{CO})_4$ ,  $\text{XeO}_2\text{F}_2$ ,  $[\text{PtCl}_4]^{2-}$ ,  $\text{XeF}_4$ , and  $\text{SOCl}_2$ , the total number of species having  $sp^3$  hybridised central atom is \_\_\_\_\_.

Ans. (5)

10. Consider the following molecules :  $\text{Br}_3\text{O}_8$ ,  $\text{F}_2\text{O}$ ,  $\text{H}_2\text{S}_4\text{O}_6$ ,  $\text{H}_2\text{S}_5\text{O}_6$ , and  $\text{C}_3\text{O}_2$ .  
 Count the number of atoms existing in their zero oxidation state in each molecule. Their sum is \_\_\_\_.

Ans. (6)

11. For  $\text{He}^+$ , 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<sup>-1</sup>]

Ans. (30)

12. 50 mL of 0.2 molal urea solution (density =  $1.012$  g mL<sup>-1</sup> 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<sup>-1</sup>; gas constant,  $R = 62$  L Torr K<sup>-1</sup> mol<sup>-1</sup> ; Assume,  $\Delta_{\text{mix}}H = 0$ ,  $\Delta_{\text{mix}}V = 0$ ]

Ans. (682)

13. The reaction of 4-methyloct-ene (**P**, 2.52 g) with HBr in the presence of  $(\text{C}_6\text{H}_5\text{CO})_2\text{O}_2$  gives two isomeric bromides in a 9 : 1 ratio, with 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 eq.  $\text{K}_2\text{CO}_3$  to given a non-ionic product **S** in 100% yield.

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

[Use molar mass (in g mol<sup>-1</sup>) : H = 1, C = 12, N = 14, Br = 80]

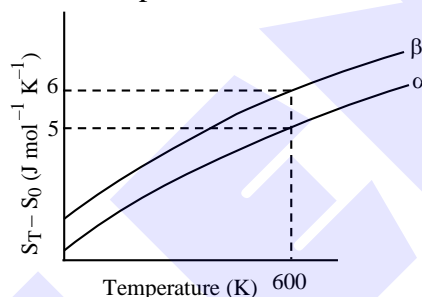
Ans. (1791)

**SECTION-4 : (Maximum Marks : 12)**

- This section contains **TWO (02)** 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 onscreen 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 in the designated place;  
*Zero Marks* : 0 In all other cases.

**"PARAGRAPH I"**

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

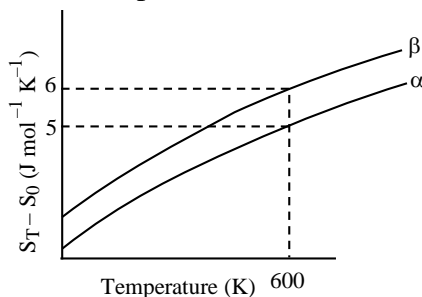
- 14.** The value of entropy change,  $S_\beta - S_\alpha$  (in  $\text{J mol}^{-1} \text{ K}^{-1}$ ), at 300 K is \_\_\_\_.  
 [Use :  $\ln 2 = 0.69$   
 Given :  $S_\beta - S_\alpha = 0$  at 0 K]

**Ans. (0.31)**

"PARAGRAPH I"

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

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

Ans. (300)

"PARAGRAPH II"

A trinitro compound, 1, 3,5 tris-(4-nitrophenyl) benzene, on complete reaction with an excess of  $\text{Sn/HCl}$  gives major product, which on treatment with an excess of  $\text{NaNO}_2/\text{HCl}$  at  $0^\circ\text{C}$  provides **P** as the product. **P**, upon treatment with excess of  $\text{H}_2\text{O}$  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  $474 \text{ mol}^{-1}$  and between compounds **P** and **S** is  $172.5 \text{ g mol}^{-1}$ .

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

[Use: Molar mass (in  $\text{g mol}^{-1}$ ):  $\text{H} = 1$ ,  $\text{C} = 12$ ,  $\text{N} = 14$ ,  $\text{O} = 16$ ,  $\text{Br} = 80$ ,  $\text{Cl} = 35.5$

Atoms other than  $\text{C}$  and  $\text{H}$  are considered as heteroatoms]

Ans. (9)



**"PARAGRAPH II"**

A trinitro compound, 1, 3,5 tris-(4-nitrophenyl) benzene, on complete reaction with an excess of Sn/HCl gives major product, which on treatment with an excess of NaNO<sub>2</sub>/HCl at 0°C provides **P** as the product. **P**, upon treatment with excess of H<sub>2</sub>O 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 mol<sup>-1</sup> and between compounds **P** and **S** is 172.5 g mol<sup>-1</sup>.

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

[Use: Molar mass in g mol<sup>-1</sup>]: 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)**