

## JEE ADVANCED-2017

### CHEMISTRY

#### General Instructions :



1. This sealed booklet is your Question Paper. Do not break the seal till you are instructed to do so.
2. The question paper CODE is printed on the left hand top corner of this sheet and the right hand top corner of the back cover of this booklet.
3. Use the Optical Response Sheet (ORS) provided separately for answering the questions.
4. The paper CODE is printed on its left part as well as the right part of the ORS. Ensure that both these codes are identical and same as that on the question paper booklet. If not contact the invigilator.
5. Blank spaces are provided within this booklet for rough work.
6. Write your name and roll number in the space provided on the back cover of this booklet
7. After breaking the seal of the booklet at 2:00 am, verify that the booklet contains 36 pages and that all the 54 questions along with the options are legible. If not contact the invigilator for replacement of the booklet.
8. You are allowed to take away the Question Paper at the end of the examination.

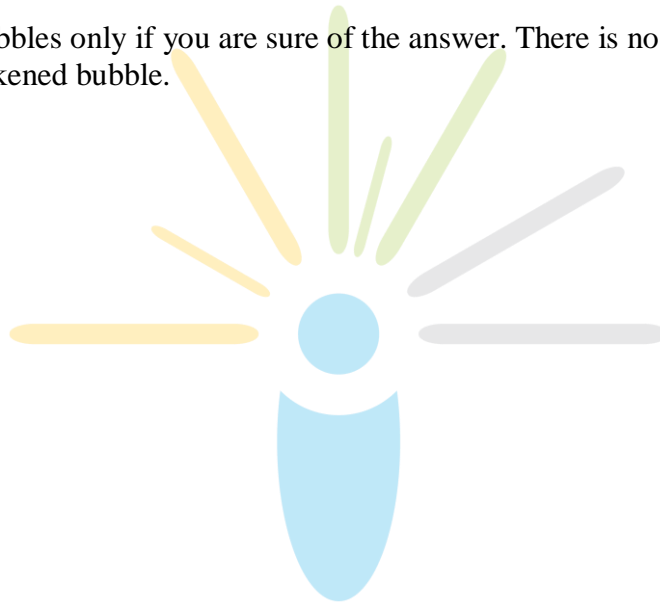
#### Optical Response Sheet

9. The ORS (top sheet) will be provided with an attached Candidate's Sheet (bottom sheet).  
  
The Candidate's Sheet is a carbon - less copy of the ORS.
10. Darken the appropriate bubbles on the ORS by applying sufficient pressure. This will leave an impression at the corresponding place on the Candidate's Sheet.
11. The ORS will be collected by the invigilator at the end of the examination.
12. You will be allowed to take away the Candidate's Sheet at the end of the examination.
13. Do not tamper with or mutilate the ORS. Do not use the ORS for rough work.

14. Write your name, roll number and code of the examination center, and sign with pen in the space provided for this purpose on the ORS. Do not write any of these details anywhere else on the ORS. Darken the appropriate bubble under each digit of your roll number.

**Darken the Bubbles on the ORS**

15. Use a Black Ball Point Pen to darken the bubbles on the ORS.
16. Darken the bubble  completely.
17. The correct way of darkening a bubble is as: 
18. The ORS is machine - gradable. Ensure that the bubbles are darkened in the correct way.
19. Darken the bubbles only if you are sure of the answer. There is no way to erase or "un-darken" a darkened bubble.



## SECTION -1

(Maximum Marks : 21)

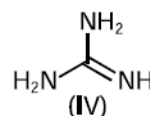
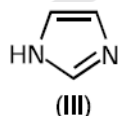
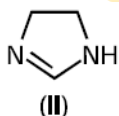
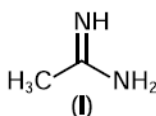
- This section contains **SEVEN** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 If only the bubble corresponding to the correct option is darkened.

Zero Marks : 0 If none of the bubbles is darkened.

Negative Marks : -1 In all other cases.

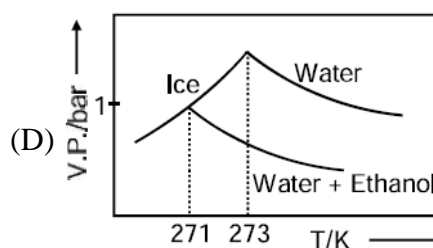
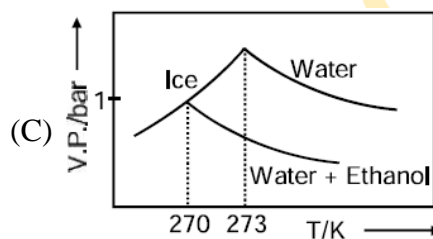
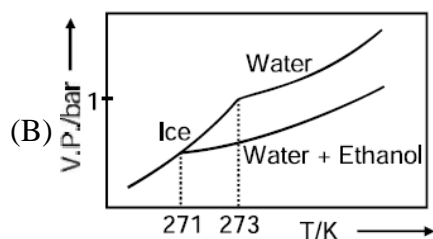
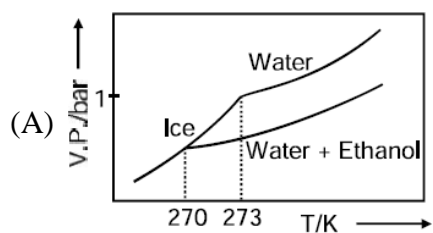
19. The order of basicity among the following compounds is



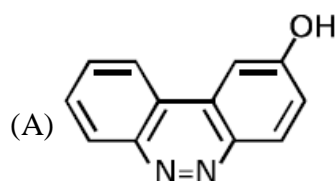
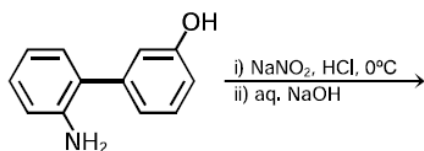
- (A) II > I > IV > III
- (B) I > IV > III > II
- (C) IV > II > III > I
- (D) IV > II > I > III

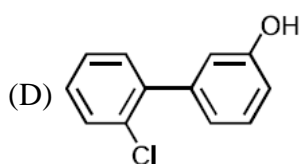
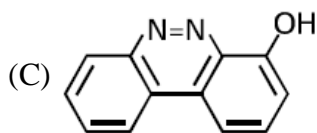
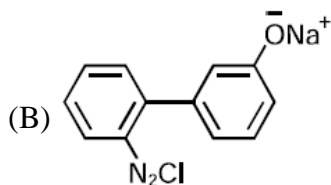
20. Pure water freezes at 273K and 1bar. The addition of 34.5g of ethanol to 500g of water changes the freezing point of the solution. Use the freezing point depression constant of water as  $2\text{K kg mol}^{-1}$ . The figures shown below represent plots of vapour pressure (V.P.) versus temperature (T). [molecular weight of ethanol is  $46\text{ g mol}^{-1}$ ]

Among the following, the option representing change in the freezing point is



21. The major product of the following reaction is





22. For the following cell,  $\text{Zn(s)} | \text{ZnSO}_4(\text{aq}) || \text{CuSO}_4(\text{aq}) | \text{Cu(s)}$  when the concentration of  $\text{Zn}^{2+}$  is 10 times the concentration of  $\text{Cu}^{2+}$ , the expression  $\Delta G$  (in  $\text{J mol}^{-1}$ ) is [  $F$  is Faraday constant;  $R$  is gas constant;  $T$  is temperature;  $E^\circ(\text{cell}) = 1.1\text{V}$  ]

(A)  $2.303RT + 1.1F$

(B)  $1.1F$  Ans.

(C)  $2.303RT - 2.2F$

(D)  $-2.2F$

23. The order of the oxidation state of the phosphorus atom in  $\text{H}_3\text{PO}_2$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{H}_3\text{PO}_3$ , and  $\text{H}_4\text{P}_2\text{O}_6$  is

(A)  $\text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_3 > \text{H}_4\text{P}_2\text{O}_6$

(B)  $\text{H}_3\text{PO}_4 > \text{H}_4\text{P}_2\text{O}_6 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2$

(C)  $\text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_3 > \text{H}_4\text{P}_2\text{O}_6 > \text{H}_3\text{PO}_4$

(D)  $\text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_4 > \text{H}_4\text{P}_2\text{O}_6$

24. The standard state Gibbs free energies of formation of C (graphite) and C (diamond) at  $T = 298\text{K}$  are

$$\Delta_f G^\circ [\text{C}(\text{graphite})] = 0 \text{ kJ mol}^{-1}$$

$$\Delta_f G^\circ [\text{C}(\text{diamond})] = 2.9 \text{ kJ mol}^{-1}$$

The standard state means that the pressure should be 1 bar, and substance should be pure at a given temperature. The conversion of graphite [C (graphite)] to diamond [C (diamond)] reduces its volume by  $2 \times 10^{-6} \text{ m}^3 \text{ mol}^{-1}$ . If C (graphite) is converted to C (diamond) isothermally at  $T = 298\text{K}$ , the pressure at which C (graphite) is in equilibrium with C (diamond), is

[Useful information:  $1\text{J} = 1\text{kg m}^2 \text{s}^{-2}$ ,  $1\text{Pa} = 1\text{kg m}^{-1} \text{s}^{-2}$ ;  $1\text{bar} = 10^5 \text{Pa}$ ]

(A) 58001 bar

(B) 1450 bar

(C) 14501 bar

(D) 29001 bar

25. Which of the following combination will produce  $\text{H}_2$  gas?

(A) Fe metal and cone.  $\text{HNO}_3$

(B) Cu metal and cone.  $\text{HNO}_3$

(C) Au metal and  $\text{NaCN}(\text{aq})$  in the presence of air

(D) Zn metal and  $\text{NaOH}(\text{aq})$

## SECTION -2

**(Maximum Marks : 28)**

- This section contains **SEVEN** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THEN ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +4 If only the bubble(s) corresponding to all the correct option(s) is darkened.

Zero Marks : 0 If none of the bubbles is darkened.

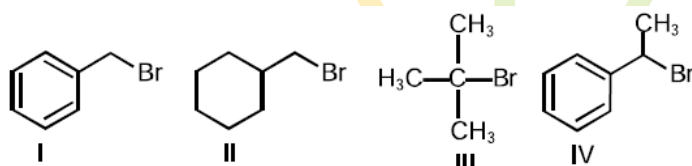
Negative Marks : -2 In all other cases.

- For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

26. For a reaction taking place in a container in equilibrium with its surroundings, the effect of temperature on its equilibrium constant  $K$  in terms of change in entropy is described by
- (A) With increase in temperature, the value of  $K$  for endothermic reaction increases because unfavourable change in entropy of the surroundings decreases
- (B) With increase in temperature, the value of  $K$  for exothermic reaction decreases because unfavourable change in entropy of the surroundings decreases
- (C) With increase in temperature, the value of  $K$  for endothermic reaction increases because the entropy change of the system is negative
- (D) With increase in temperature, the value of  $K$  for exothermic reaction decreases because the entropy change of the system is positive

27. In a bimolecular reaction, the steric factor  $P$  was experimentally determined to be 4.5. the correct option(s) among the following is(are)
- (A) The activation energy of the reaction is unaffected by the value of the steric factor.
- (B) Experimentally determined value of frequency factor is higher than that predicted by Arrhenius equation.
- (C) The value of frequency factor predicted by Arrhenius equation is higher than that determined experimentally.
- (D) Since  $P = 4.5$ , the reaction will not proceed unless an effective catalyst is used.

28. For the following compounds, the correct statement(s) with respect to nucleophilic substitution reaction is (are)

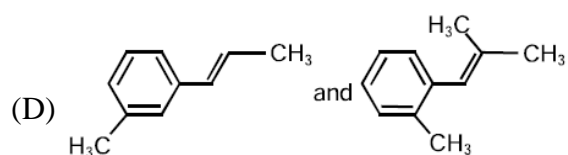
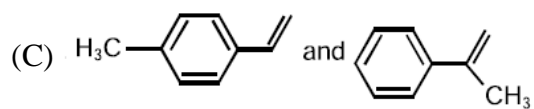
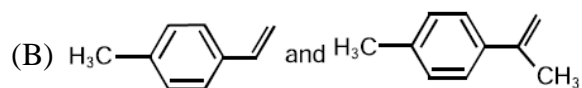
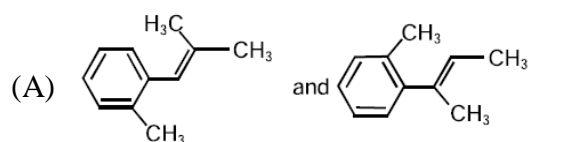


- (A) Compound IV undergoes inversion of configuration
- (B) The order of reactivity for I, III and IV is :
- (C) I and III follow  $S_N1$  mechanism
- (D) I and II follow  $S_N2$  mechanism
29. Among the following, the correct statement(s) is(are)
- (A)  $\text{Al}(\text{CH}_3)_3$  has the three-centre two-electron bonds in its dimeric structure.
- (B) The Lewis acidity of  $\text{BCl}_3$  is greater than that of  $\text{AlCl}_3$
- (C)  $\text{AlCl}_3$  has the three-centre two-electron bonds in its dimeric structure.
- (D)  $\text{BH}_3$  has the three-centre two-electron bonds in its dimeric structure.



30. The option(s) with only amphoteric oxides is(are)
- (A)  $\text{NO}, \text{B}_2\text{O}_3, \text{PbO}, \text{SnO}_2$
- (B)  $\text{Cr}_2\text{O}_3, \text{CrO}, \text{SnO}, \text{PbO}$
- (C)  $\text{Cr}_2\text{O}_3, \text{BeO}, \text{SnO}, \text{SnO}_2$
- (D)  $\text{ZnO}, \text{Al}_2\text{O}_3, \text{PbO}, \text{PbO}_2$
31. The correct statement(s) about surface properties is(are)
- (A) The critical temperatures of ethane and nitrogen are 563K and 126K, respectively. The adsorption of ethane will be more than that of nitrogen of same amount of activated charcoal at a given temperature.
- (B) Cloud is an emulsion type of colloid in which liquid is dispersed phase and gas is dispersion medium.
- (C) Adsorption is accompanied by decrease in enthalpy and decrease in entropy of the system.
- (D) Brownian motion of colloidal particles does not depend on the size of the particles but depends on viscosity of the solution.
32. Compound  $P$  and  $R$  upon ozonolysis produce  $Q$  and  $S$ , respectively. The molecular formula of  $Q$  and  $S$  is  $\text{C}_8\text{H}_8\text{O}$ .  $Q$  undergoes Cannizzaro reaction but not haloform reaction, whereas  $S$  undergoes haloform reaction but not Cannizzaro reaction.
- (i) 
$$P \xrightarrow[\text{ii) Zn/H}_2\text{O}]{\text{i) O}_3/\text{CH}_2\text{Cl}_2} \underset{(\text{C}_8\text{H}_8\text{O})}{Q}$$
- (ii) 
$$R \xrightarrow[\text{ii) Zn/H}_2\text{O}]{\text{i) O}_3/\text{CH}_2\text{Cl}_2} \underset{(\text{C}_8\text{H}_8\text{O})}{S}$$

The option(s) with suitable combination of *P* and *R*, respectively, is(are)



**SECTION – 3**

**(Maximum Marks : 12)**

- This section contains **TWO** paragraphs.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3 If only the bubble corresponding to the correct answer is darkened.

Zero Marks : 0 In all other cases.

**PARAGRAPH -1**

Upon heating  $\text{KClO}_3$  in the presence of catalytic amount of  $\text{MnO}_2$ , a gas **W** is formed. Excess amount of **W** reacts with white phosphorus to give **X**. The reaction of **X** with pure  $\text{HNO}_3$  gives **Y** and **Z**.

33. **Y** and **Z** are, respectively
- (A)  $\text{N}_2\text{O}_4$  and  $\text{HPO}_3$
- (B)  $\text{N}_2\text{O}_4$  and  $\text{H}_3\text{PO}_3$
- (C)  $\text{N}_2\text{O}_3$  and  $\text{H}_3\text{PO}_4$
- (D)  $\text{N}_2\text{O}_5$  and  $\text{HPO}_3$
34. **W** and **X** are, respectively
- (A)  $\text{O}_2$  or  $\text{P}_4\text{O}_{10}$

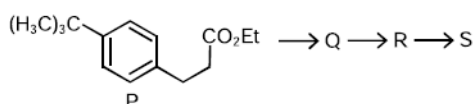
(B)  $O_2$  or  $P_4O_6$

(C)  $O_3$  or  $P_4O_6$

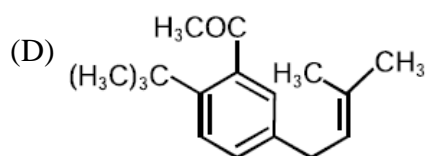
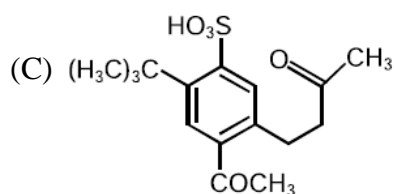
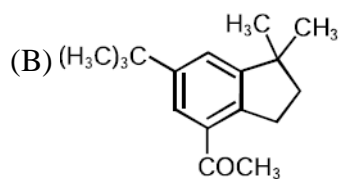
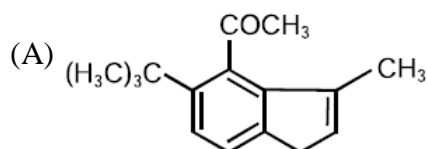
(D)  $O_3$  or  $P_4O_{10}$

## Paragraph 2

The reaction of compound *P* with  $CH_3MgBr$  (excess) in  $(C_2H_5)_2O$  followed by addition of  $H_2O$  gives *Q*. The compound *Q* on treatment with  $H_2SO_4$  at  $0^\circ C$  gives *R*. The reaction of *R* with  $CH_3COCl$  in the presence of anhydrous  $AlCl_3$  in  $CH_2Cl_2$  followed by treatment with  $H_2O$  produces compound *S*. [Et in compound *P* is ethyl group]



35. The product *S* is



36. The reactions,  $Q$  to  $R$  to  $S$ , are

- (A) Aromatic sulfonation and Friedei-Crafts acylation
- (B) Friedei-Crafts alkylation and Friedei-Crafts acylation
- (C) Friedei-Crafts alkylation, dehydration and Friedei-Crafts acylation
- (D) Dehydration and Friedei-Crafts acylation

