



Series RRSS2/2



SET-1

प्रश्न-पत्र कोड
Q.P. Code

56/2/1

रोल नं.

Roll No.

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परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।

Candidates must write the Q.P. Code on the title page of the answer-book.

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित (I) पृष्ठ 27 हैं ।

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में (II) 33 प्रश्न हैं ।

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए (III) प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(IV) कृपया प्रश्न का उत्तर लिखना शुरू करने से (IV) पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का (V) समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

NOTE

Please check that this question paper contains 27 printed pages.

Please check that this question paper contains 33 questions.

Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

Please write down the serial number of the question in the answer-book before attempting it.

15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

रसायन विज्ञान (सैद्धान्तिक)

CHEMISTRY (Theory)

निर्धारित समय : 3 घण्टे

Time allowed : 3 hours

अधिकतम अंक : 70

Maximum Marks : 70



General Instructions :

Read the following instructions carefully and follow them :

- (i) *This question paper contains **33** questions. **All** questions are **compulsory**.*
- (ii) *This question paper is divided into **five** sections – **Section A, B, C, D and E**.*
- (iii) ***Section A** – questions number **1** to **16** are multiple choice type questions. Each question carries **1** mark.*
- (iv) ***Section B** – questions number **17** to **21** are very short answer type questions. Each question carries **2** marks.*
- (v) ***Section C** – questions number **22** to **28** are short answer type questions. Each question carries **3** marks.*
- (vi) ***Section D** – questions number **29** and **30** are case-based questions. Each question carries **4** marks.*
- (vii) ***Section E** – questions number **31** to **33** are long answer type questions. Each question carries **5** marks.*
- (viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.*
- (ix) *Kindly note that there is a separate question paper for Visually Impaired candidates.*
- (x) *Use of calculators is **not** allowed.*

SECTION A

*Questions no. **1** to **16** are Multiple Choice type Questions, carrying **1** mark each.*

16×1=16

1. When MnO_2 is fused with KOH in air, it gives :

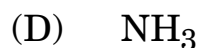
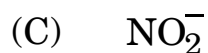
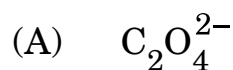
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|-----------------------------|------------------------------|
| (A) KMnO_4 | (B) K_2MnO_4 |
| (C) Mn_2O_7 | (D) Mn_2O_3 |

2. Ligand EDTA^{4-} is an example of a :

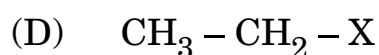
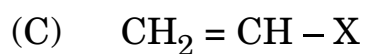
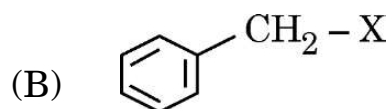
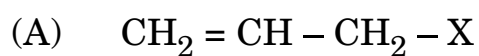
- (A) Monodentate ligand
- (B) Didentate ligand
- (C) Tridentate ligand
- (D) Polydentate ligand



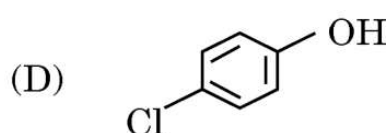
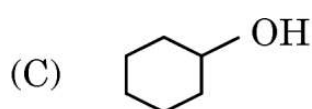
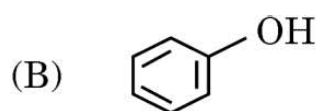
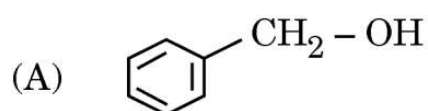
3. Which of the following ligand forms chelate complex ?



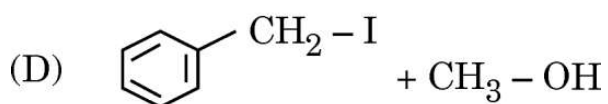
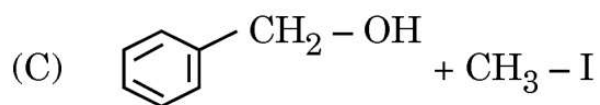
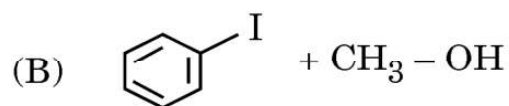
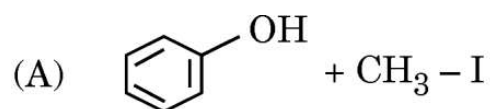
4. Which of the following contains sp^2 hybridised carbon bonded to X ?



5. Which of the following is most acidic ?



6. Anisole reacts with HI to give :





7. Ethanol on heating with conc. H_2SO_4 at 413 K gives :
- (A) $\text{C}_2\text{H}_5\text{OSO}_3\text{H}$
 - (B) $\text{C}_2\text{H}_5 - \text{O} - \text{CH}_3$
 - (C) $\text{C}_2\text{H}_5 - \text{O} - \text{C}_2\text{H}_5$
 - (D) $\text{CH}_2 = \text{CH}_2$
8. An azeotropic solution of two liquids has boiling point lower than either of them when it :
- (A) is saturated
 - (B) shows positive deviation from Raoult's law
 - (C) shows negative deviation from Raoult's law
 - (D) shows no deviation from Raoult's law
9. The relative lowering of vapour pressure of an aqueous solution containing non-volatile solute is 0.0225. The mole fraction of the non-volatile solute is :
- (A) 0.80
 - (B) 0.725
 - (C) 0.15
 - (D) 0.0225
10. During electrolysis of aqueous solution of NaCl :
- (A) H_2 (g) is liberated at cathode
 - (B) Na is formed at cathode
 - (C) O_2 (g) is liberated at anode
 - (D) Cl_2 (g) is liberated at cathode



11. The addition of catalyst during a chemical reaction alters which of the following quantities of the reaction ?
- (A) Enthalpy
 - (B) Activation energy
 - (C) Entropy
 - (D) Internal energy
12. For the elementary reaction $P \rightarrow Q$, the rate of disappearance of 'P' increases by a factor of 8 upon doubling the concentration of 'P'. The order of the reaction with respect to 'P' is :
- (A) 3
 - (B) 4
 - (C) 2
 - (D) 1

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

- (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
- (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
- (C) Assertion (A) is true, but Reason (R) is false.
- (D) Assertion (A) is false, but Reason (R) is true.



13. *Assertion (A)* : Aliphatic primary amines can be prepared by Gabriel phthalimide synthesis.

Reason (R) : Alkyl halides undergo nucleophilic substitution with anion formed by phthalimide.

14. *Assertion (A)* : Uracil base is present in DNA.

Reason (R) : DNA undergoes self-replication.

15. *Assertion (A)* : Diazonium salts of aromatic amines are more stable than those of aliphatic amines.

Reason (R) : Diazonium salts of aliphatic amines show resonance.

16. *Assertion (A)* : *p*-nitroaniline is a weaker base than *p*-toluidine.

Reason (R) : The electron withdrawing effect of $-\text{NO}_2$ group in *p*-nitroaniline makes it a weaker base.

SECTION B

17. A 6% solution of glucose (molar mass = 180 g mol^{-1}) is isotonic with 2.5% solution of an unknown organic substance. Calculate the molecular weight of the unknown organic substance. 2

18. A first order reaction has a rate constant $1.25 \times 10^{-3} \text{ s}^{-1}$. How long will 5 g of this reactant take to reduce to 2.5 g ? 2

[$\log 2 = 0.301$, $\log 3 = 0.4771$, $\log 4 = 0.6021$]



19. (a) What is lanthanoid contraction ? Actinoid contraction is greater from element to element than lanthanoid contraction. Why ? $1+1=2$

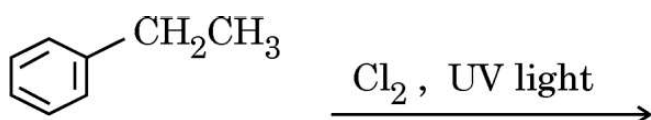
OR

- (b) Why do transition metals have high enthalpy of atomization ? Which element of 3d-series has lowest enthalpy of atomization ? $1+1=2$

20. (a) In the following pair of compounds, which compound undergoes S_N2 reaction faster and why ?



- (b) Write the major product in the following : $1+1=2$

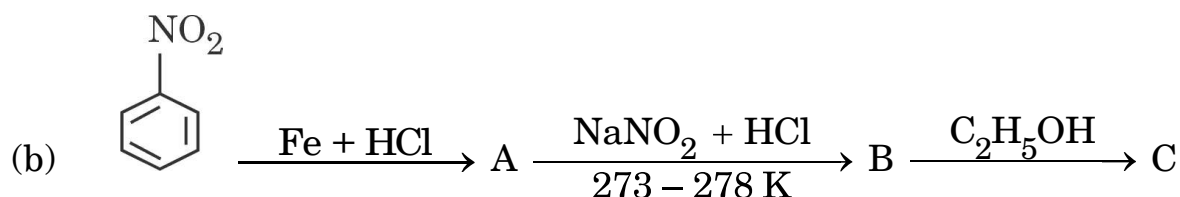


21. Define the following terms : $2 \times 1 = 2$

- (a) Denaturation of protein
(b) Invert sugar

SECTION C

22. Write the structures of A, B and C in the following reactions : $2 \times 1 \frac{1}{2} = 3$





- 23.** Write the reaction involved in the following : $3 \times 1 = 3$
- (a) Wolff-Kishner reduction
 - (b) Decarboxylation reaction
 - (c) Cannizzaro reaction
- 24.** Give the equations of reactions for the preparation of : (any *three*) $3 \times 1 = 3$
- (a) Phenol from chlorobenzene
 - (b) Salicylaldehyde from phenol
 - (c) 2-Methoxyacetophenone from anisole
 - (d) Picric acid from phenol
- 25.** Give reasons for the following : $3 \times 1 = 3$
- (a) Chlorine is ortho/para directing in electrophilic aromatic substitution reactions, though chlorine is an electron withdrawing group.
 - (b) Racemic mixture is optically inactive.
 - (c) Allyl chloride is hydrolysed more readily than n-propyl chloride.
- 26.** The vapour pressure of a solvent at 283 K is 100 mm Hg. Calculate the vapour pressure of a dilute solution containing 1 mole of a strong electrolyte AB in 50 moles of the solvent at 283 K (assuming complete dissociation of solute AB). 3



27. Calculate emf of the following cell :

3



$$\text{Given : } E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0.76 \text{ V, } E_{\text{Sn}^{2+}/\text{Sn}}^{\circ} = -0.14 \text{ V}$$

$$[\log 10 = 1]$$

28. The rate of a gaseous reaction triples when temperature is increased from 17°C to 27°C. Calculate the energy of activation for this reaction.

3

$$[\text{Given : } 2.303 R = 19.15 \text{ JK}^{-1} \text{ mol}^{-1}, \log 3 = 0.48]$$

SECTION D

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. Carbohydrates are essential for life in both plants and animals. Carbohydrates are used as storage molecules as starch in plants and glycogen in animals. Chemically they are polyhydroxy aldehydes or ketones. On the basis of their behaviour on hydrolysis, carbohydrates are classified as monosaccharides, oligosaccharides and polysaccharides. All monosaccharides are reducing sugars, i.e., they are oxidized by Tollens' reagent and Fehling's solution. A monosaccharide like glucose is aldohexose and its molecular formula was found to be $\text{C}_6\text{H}_{12}\text{O}_6$. After reacting with different reagents like HI, $\text{H}_2\text{N}-\text{OH}$, Bromine water, $(\text{CH}_3\text{CO})_2\text{O}$, etc. its structure was found to contain one aldehyde group, one primary alcoholic group, $(-\text{CH}_2\text{OH})$ and four secondary alcoholic groups $(>\text{CHOH})$. Despite having the aldehyde group, glucose does not give some of the reactions of aldehyde group like Schiff's test, NaHSO_3 addition. This explains the existence of glucose in two cyclic hemiacetal forms which differ only in the configuration of the hydroxyl group at C - 1.



Answer the following questions :

- (a) What are reducing sugars ? 1
- (b) Classify the following into monosaccharide and disaccharide :
Fructose, Sucrose, Lactose, Galactose 1
- (c) Name the polysaccharide which is known as 'animal starch'. Why is it called 'animal starch' ? 2

OR

- (c) (i) Name the isomers of glucose which in the cyclic form differ only in the configuration of the – OH group at C – 1.
- (ii) Presence of which functional group was detected when glucose reacted with Br₂ water ? 2×1=2

30. Transition metals have incomplete d-subshell either in neutral atom or in their ions. The presence of partly filled d-orbitals in their atoms makes transition elements different from that of the non-transition elements. With partly filled d-orbitals, these elements exhibit certain characteristic properties such as display of a variety of oxidation states, formation of coloured ions and entering into complex formation with a variety of ligands. The transition metals and their compounds also exhibit catalytic properties and paramagnetic behaviour. The transition metals are very hard and have low volatility. An examination of the $E_{M^{2+}/M}^0$ values shows the varying trends :



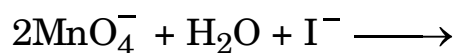
$E^{\circ}_{M^{2+}/M}$	
V	- 1.18
Cr	- 0.91
Mn	- 1.18
Fe	- 0.44
Co	- 0.28
Ni	- 0.25
Cu	+ 0.34
Zn	- 0.76

Answer the following questions :

- (a) On what basis can we say that Cu is a transition element but Zn is not ? (Atomic number : Cu = 29, Zn = 30) 1
- (b) Why do transition elements show variety of oxidation states ? 1
- (c) (i) Why do $E^{\circ}_{M^{2+}/M}$ values show irregular trend from Vanadium to Zinc ?
- (ii) How is the variability in oxidation states of transition metals different from that of the non-transition elements ? 2×1=2

OR

- (c) (i) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidizing. Why ? (Atomic number : Cr = 24, Mn = 25)
- (ii) Complete the following ionic equation : 2×1=2





SECTION E

31. Answer any *five* of the following :

5×1=5

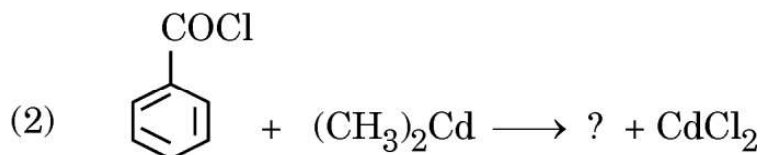
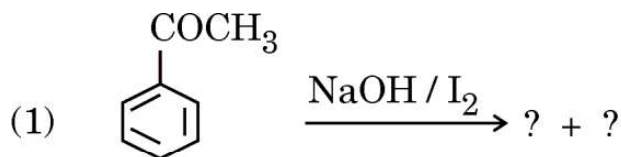
- (a) How is the crystal field splitting energy for octahedral complex (Δ_o) related to that of tetrahedral complex (Δ_t) ?
- (b) Write the IUPAC name of the following complex :
 $[\text{PtCl}_2(\text{en})_2] (\text{NO}_3)_2$
- (c) Write the geometry and magnetic behaviour of the complex $[\text{Ni}(\text{CO})_4]$ on the basis of Valency Bond Theory (VBT).
- (d) What type of isomerism is shown by the complex $[\text{Co}(\text{NH}_3)_6] [\text{Cr}(\text{CN})_6]$?
- (e) For the coordination compound on the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o < P$. Is the coordination compound a high spin or low spin complex ?
- (f) Out of $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$, which complex is heteroleptic and why ?
- (g) Draw the structures of optical isomers of $[\text{PtCl}_2(\text{en})_2]^{2+}$.

32. (a) (i) Account for the following :

- (1) Oxidation of aldehydes is easier as compared to ketones.
- (2) The alpha (α) hydrogen atoms of aldehydes are acidic in nature.



(ii) Write the products in the following reactions :

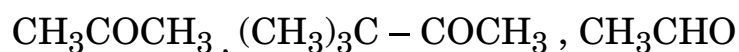


(iii) Give a simple chemical test to distinguish between ethanoic acid and ethanal. 2+2+1=5

OR

(b) (i) Draw structure of the 2,4-dinitrophenylhydrazone of benzaldehyde.

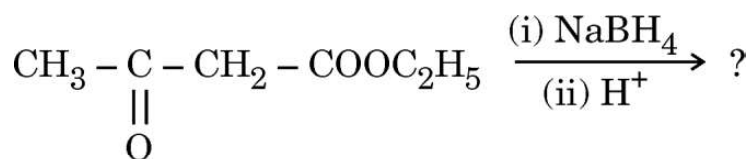
(ii) Arrange the following in increasing order of their reactivity towards HCN :



(iii) How can you convert phenyl magnesium bromide to benzoic acid ?

(iv) Give a simple chemical test to distinguish between benzaldehyde and ethanal.

(v) Write the main product in the following reaction :



5×1=5



- 33.** (a) (i) The resistance of 0.05 M CH_3COOH solution is found to be 100 ohm. If the cell constant is 0.0354 cm^{-1} , calculate the molar conductivity of the acetic acid solution.
- (ii) State Faraday's first law of electrolysis. How much charge in Faraday is required for the reduction of 1 mol of MnO_4^- to Mn^{2+} ? 3+2=5

OR

- (b) (i) The conductivity of $0.0025 \text{ mol L}^{-1}$ acetic acid is $5.25 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its degree of dissociation if Λ_m^0 for acetic acid is $390 \text{ S cm}^2 \text{ mol}^{-1}$.
- (ii) Write anode, cathode and overall reaction of lead storage battery. 3+2=5