PART I : CHEMISTRY

SECTION – I (Total Marks : 24)

(Single Correct Answer Type)

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

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1. Oxidation states of the metal in the minerals haematite and magnetite, respectively, are

   (A) II, III in haematite and III in magnetite
   (B) II, III in haematite and II in magnetite
   (C) II in haematite and II, III in magnetite
   (D) III in haematite and II, III in magnetite

ANSWER: D

2. Among the following complexes (**K**–**P**),
   $K_3[Fe(CN)_6]$ (**K**), $[Co(NH_3)_6]Cl_3$ (**L**), $Na_3[Co(oxalate)_3]$ (**M**), $[Ni(H_2O)_6]Cl_2$ (**N**),
   $K_2[Pt(CN)_4]$ (**O**) and $[Zn(H_2O)_6](NO_3)_2$ (**P**)
   the diamagnetic complexes are

   (A) **K, L, M, N** (B) **K, M, O, P** (C) **L, M, O, P** (D) **L, M, N, O**

ANSWER: C

3. Passing H_2S gas into a mixture of Mn^{2+}, Ni^{2+}, Cu^{2+} and Hg^{2+} ions in an acidified aqueous solution precipitates

   (A) CuS and HgS (B) MnS and CuS
   (C) MnS and NiS (D) NiS and HgS

ANSWER: A

4. Consider the following cell reaction:
   $2Fe_{(s)} + O_{2(g)} + 4H^+_{(aq)} \rightarrow 2Fe^{2+}_{(aq)} + 2H_2O(l)$ $E^\circ = 1.67$ V
   At $[Fe^{2+}] = 10^{-3}$ M, $P(O_2) = 0.1$ atm and pH = 3, the cell potential at 25 °C is

   (A) 1.47 V (B) 1.77 V (C) 1.87 V (D) 1.57 V

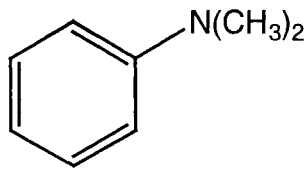
ANSWER: D

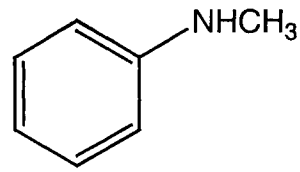
5. The freezing point (in ^{o}C) of a solution containing 0.1 g of $K_3[Fe(CN)_6]$ (Mol. Wt. 329) in 100 g of water (K_f = 1.86 K kg mol^{-1}) is

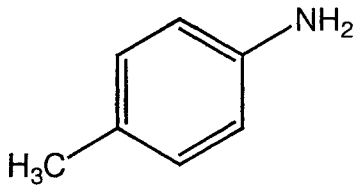
(A) -2.3×10^{-2} (B) -5.7×10^{-2} (C) -5.7×10^{-3} (D) -1.2×10^{-2}

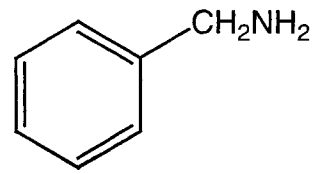
ANSWER: A

6. Amongst the compounds given, the one that would form a brilliant colored dye on treatment with $NaNO_2$ in dil. HCl followed by addition to an alkaline solution of β-naphthol is

(A) 

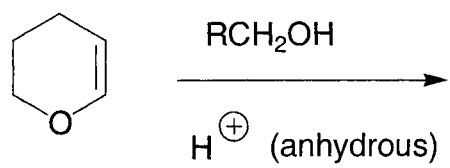
(B) 

(C) 

(D) 

ANSWER: C

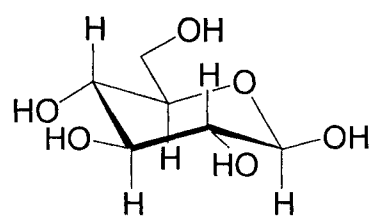
7. The major product of the following reaction is



(A) a hemiacetal (B) an acetal
(C) an ether (D) an ester

ANSWER: B

8. The following carbohydrate is



(A) a ketohexose (B) an aldohexose
(C) an α-furanose (D) an α-pyranose

ANSWER: B

SECTION – II (Total Marks : 16)

(Multiple Correct Answer(s) Type)

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** may be correct.

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9. Reduction of the metal centre in aqueous permanganate ion involves

(A) 3 electrons in neutral medium (B) 5 electrons in neutral medium

(C) 3 electrons in alkaline medium (D) 5 electrons in acidic medium

ANSWER : ACD

10. The equilibrium

$2\,Cu^{I} \rightleftharpoons Cu^{O} + Cu^{II}$

in aqueous medium at 25 °C shifts towards the left in the presence of

(A) NO_3^- (B) Cl^- (C) SCN^- (D) CN^-

ANSWER : BCD

11. For the first order reaction

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

(A) the concentration of the reactant decreases exponentially with time.

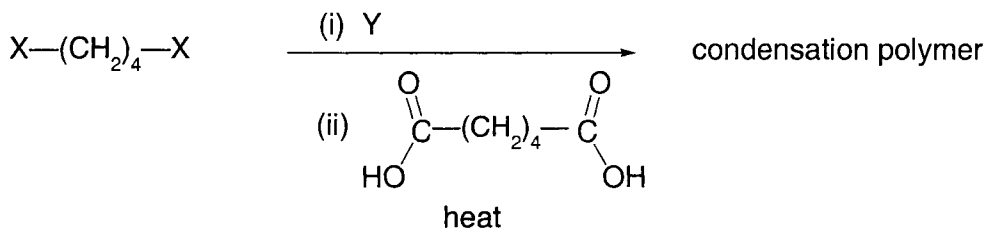
(B) the half-life of the reaction decreases with increasing temperature.

(C) the half-life of the reaction depends on the initial concentration of the reactant.

(D) the reaction proceeds to 99.6 % completion in eight half-life duration.

ANSWER: ABD

12. The correct functional group X and the reagent/reaction conditions Y in the following scheme are



(A) $X = COOCH_3$, $Y = H_2/Ni/heat$ (B) $X = CONH_2$, $Y = H_2/Ni/heat$

(C) $X = CONH_2$, $Y = Br_2/NaOH$ (D) $X = CN$, $Y = H_2/Ni/heat$

ANSWER: CD

SECTION – III (Total Marks : 24)

(Integer Answer Type)

This section contains **6 questions.** The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

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13. Among the following, the nurnber of compounds than can react with PCl_5 to give $POCl_3$ is

O_2, CO_2, SO_2, H_2O, H_2SO_4, P_4O_{10}

ANSWER: 4

14. The volume (in mL) of 0.1 M $AgNO_3$ required for complete precipitation of chloride ions present in 30 mL of 0.01 M solution of $[Cr(H_2O)_5Cl]Cl_2$, as silver chloride is close to

ANSWER: 6

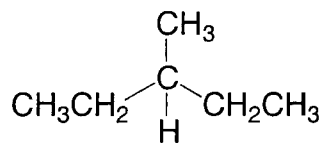
15. In 1 L saturated solution of AgCl [$K_{sp}(AgCl) = 1.6 \times 10^{-10}$], 0.1 mol of CuCl [$K_{sp}(CuCl) = 1.0 \times 10^{-6}$] is added. The resultant concentration of Ag^+ in the solution is 1.6×10^{-x}. The value of "x" is

ANSWER: 7

16. The number of hexagonal faces that are present in a truncated octahedron is

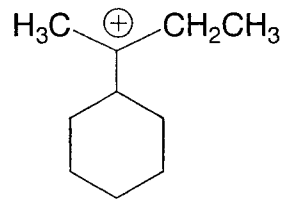
ANSWER: 8

17. The maximum number of isomers (including stereoisomers) that are possible on mono-chlorination of the following compound, is



ANSWER: 8

18. The total number of contributing structures showing hyperconjugation (involving C-H bonds) for the following carbocation is



ANSWER: 6

SECTION – IV (Total Marks : 16)

(Matrix-Match Type)

This section contains **2 questions**. Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II**. Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.

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19. Match the transformations in **column I** with appropriate options in **column II**

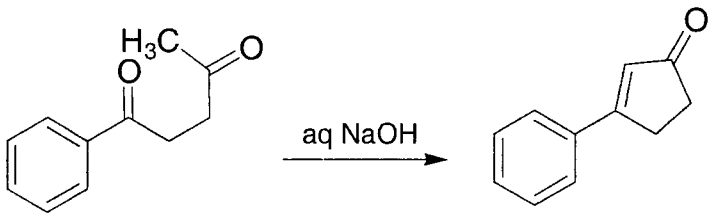
Column I		**Column II**	
(A)	$CO_2(s) \rightarrow CO_2(g)$	(p)	phase transition
(B)	$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$	(q)	allotropic change
(C)	$2\,H^{\bullet} \rightarrow H_2(g)$	(r)	ΔH is positive
(D)	$P_{(white,\ solid)} \rightarrow P_{(red,\ solid)}$	(s)	ΔS is positive
		(t)	ΔS is negative

ANSWER A : p, r and s
B : r and s
C : t
D : p, q and t

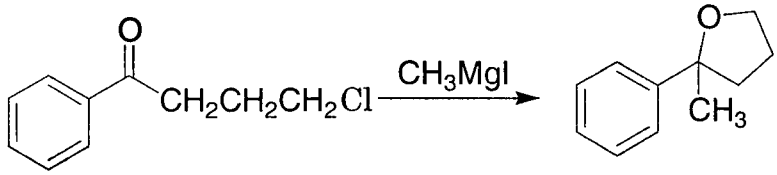
20. Match the reactions in **column I** with appropriate types of steps/reactive intermediate involved in these reactions as given in **column II**

Column I

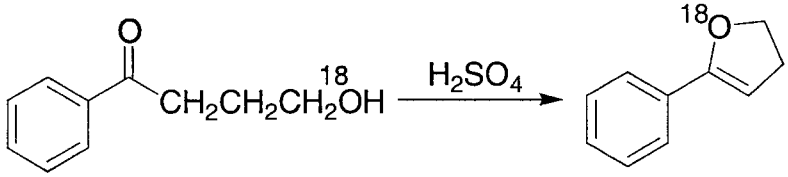
(A)



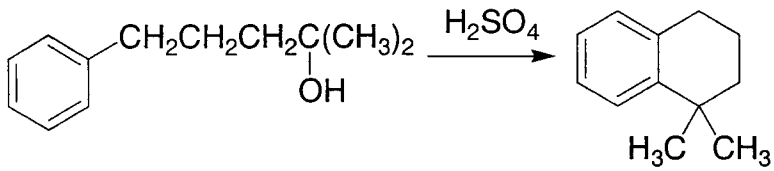
(B)



(C)



(D)



Column II

(p) Nucleophilic substitution

(q) Electrophilic substitution

(r) Dehydration

(s) Nucleophilic addition

(t) Carbanion

ANSWER A : r, s and t
B : p and s
C : r and s
D : q and r