



General Instructions

- (i) **Duration:** The total duration of the examination is 1 hours (60 minutes).
- (ii) **Total Marks:** The complete Chemistry paper carries a maximum of 100 marks.
- (iii) **Structure:** The paper consists of two sections:
 - **Section A:** 20 Multiple Choice Questions (MCQs).
 - **Section B:** 5 Numerical Value Type Questions.
- (iv) **Compulsory Questions:** All 25 questions are compulsory.
- (v) Each question has four options. Only **one** option is correct.
- (vi) **Correct Answer:** +4 marks.
- (vii) **Incorrect Answer:** –1 mark (Negative marking).
- (viii) **Unanswered/Marked for Review:** 0 marks.

Chemistry Section - A

1. How many grams of residue is obtained by heating 2.76 g of silver carbonate? (Given : Molar mass of C, O and Ag are 12, 16 and 108 g mol⁻¹ respectively)

- (A) 1.08 g
- (B) 2.16 g
- (C) 3.24 g
- (D) 4.32 g

2. Arrange the following atomic orbitals of multi electron atoms in order of increasing energy.

A. $n = 3, l = 2, m = +1$

B. $n = 4, l = 0, m = 0$

C. $n = 6, l = 1, m = 0$

D. $n = 5, l = 1, m = +1$

E. $n = 2, l = 1, m = +1$

(A) $C < D < B < A < E$

(B) $B < A < E < C < D$

(C) $E < C < D < B < A$

(D) $E < B < A < D < C$

3. Identify the correct statements from the following :

A. Heisenberg uncertainty principle is applicable to electrons.

B. The size of $2p_x$ orbital is less than the size of $3p_x$ orbital.

C. The energy of $2s$ orbital of H atom is equal to the energy of $2s$ orbital of Li.

D. The electronic configuration of Cr is $[Ar]3d^5 4s^1$

(A) A, B and C Only

(B) A, B and D Only

(C) B, C and D Only

(D) A, C and D Only

4. What is the mole fraction of water in 10% by weight (w/w) of aqueous urea solution? [Given: Molar mass of H, O, C and N are 1, 16, 12 and 14 g mol^{-1} respectively.]

(A) 0.825

(B) 0.032

(C) 0.867

(D) 0.967

5. M_3A_2 is a sparingly soluble salt of molar mass $y \text{ g mol}^{-1}$ and solubility $x \text{ g L}^{-1}$. The ratio of the molar concentration of the anion (A^{3-}) to the solubility product (K_{sp}) of the salt is:

- (A) $\frac{1}{54} \frac{y^4}{x^4}$
(B) $\frac{y^5}{108x^4}$
(C) $108 \frac{x^5}{y^5}$
(D) $\frac{1}{108} \frac{y^4}{x^4}$
-

6. Arrange the following resultant mixtures in increasing order of their pH values

- A. 10 mL 0.2 M Ca(OH)_2 + 25 mL 0.1 M HCl
B. 10 mL 0.01 M H_2SO_4 + 10 mL 0.01 M Ca(OH)_2
C. 10 mL 0.1 M H_2SO_4 + 10 mL 0.1 M KOH

- (A) $B < C < A$
(B) $C < A < B$
(C) $C < B < A$
(D) $A < C < B$
-

7. First order gas phase reaction $A \rightarrow B + C$. p_i = initial pressure of gas A,
 P_t = total pressure of the reaction mixture at time t. Expression of rate constant (k) is

- (A) $\frac{1}{t} \ln \frac{p_i}{2p_i - P_t}$
(B) $\frac{1}{t} \ln \frac{2p_i}{p_i - P_t}$
(C) $\frac{1}{t} \ln \frac{p_i}{3p_i - 2P_t}$
(D) $\frac{1}{t} \ln \frac{3p_i}{4p_i - P_t}$
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8. Given below are two statements:

Statement I: The correct order of electronegativity of fluorine, oxygen and nitrogen is $F > O > N$.

Statement II: The oxidation state of oxygen in OF_2 is +2 and in Na_2O is -2.

- (A) Both Statement I and Statement II are true
 - (B) Both Statement I and Statement II are false
 - (C) Statement I is true but Statement II is false
 - (D) Statement I is false but Statement II is true
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9. Correct statements from the following are:

- A. Nitrogen in oxidation states from +1 to +4 disproportionates in acid medium.
- B. Nitrogen has the ability to form $d\pi - p\pi$ multiple bonds with itself and other elements with small size and high electronegativity.
- C. N-N single bond is stronger than P-P single bond.
- D. Nitrogen has highest density in its group due to small size.
- E. The maximum covalency of nitrogen is four since it has only four valence orbitals for bonding.

- (A) B, C and D Only
 - (B) C, D and E Only
 - (C) A, C and E Only
 - (D) A and E Only
-

10. Which of the following is NOT a physical or chemical characteristic of interstitial compounds?

- (A) They have high melting points, higher than those of pure metals.
- (B) They are very soft and ionic in nature.
- (C) They retain metallic conductivity.
- (D) They are chemically inert and usually non-stoichiometric.

11. The correct statements about metal carbonyls are:

- A. The metal-carbon bonds in metal carbonyls possess both σ and π character.
- B. Due to synergic bonding interactions between metal and CO ligand, the metal-carbon bond becomes weak.
- C. The metal-carbon σ bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of metal.
- D. The metal-carbon π bond is formed by the donation of electrons from filled d-orbital of metal into vacant π^* orbital of CO.

- (A) A and B Only
- (B) A, C and D Only
- (C) B and C Only
- (D) A and D Only

12. Given below are two statements:

Statement I: Each electron in e_g orbitals destabilizes the orbitals by $+0.6\Delta_o$ and each electron in the t_{2g} orbitals stabilizes the orbitals by $-0.4\Delta_o$ in an octahedral field on the basis of crystal field theory.

Statement II: All the d-orbitals of the transition metals have the same energy in their free atomic state but when a complex is formed the ligands destroy the degeneracy of these orbitals on the basis of crystal field theory.

- (A) Both Statement I and Statement II are correct
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect
- (D) Statement I is incorrect but Statement II is correct

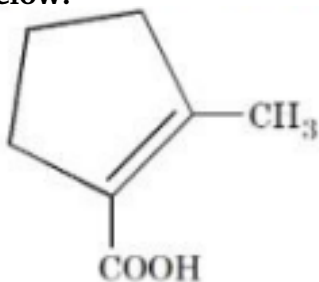
13. Given below are two statements:

Statement I: On the basis of inductive effect, the order of stability of alkyl carbanions is $CH_3^- > CH_3-CH_2^- > (CH_3)_2CH^- > (CH_3)_3C^-$.

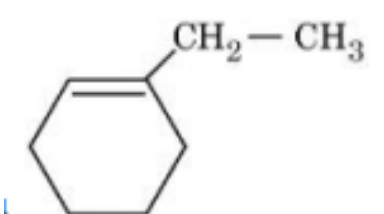
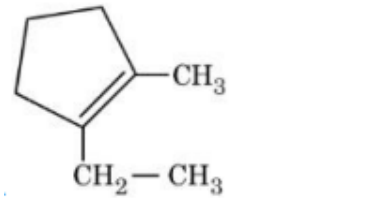
Statement II: Allyl and benzyl carbanions are more stabilised by inductive effect and not by resonance effect.

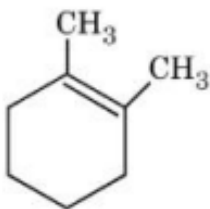
- (A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

14. "P" is a hydrocarbon of molecular formula:- C_8H_{14} . On ozonolysis, "P" forms "Q". "Q" on treatment with alkali under reflux condition produces "R", which on treatment with $I_2/NaOH$ gives a yellow precipitate. Acidification of the solution gives "S". The structure of "S" is given below:-



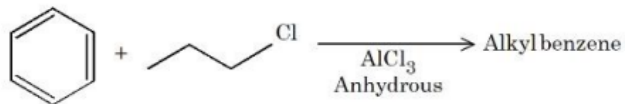
The correct structure of "P" is

- (A) 
- (B) 
- (C) 



(D) ·

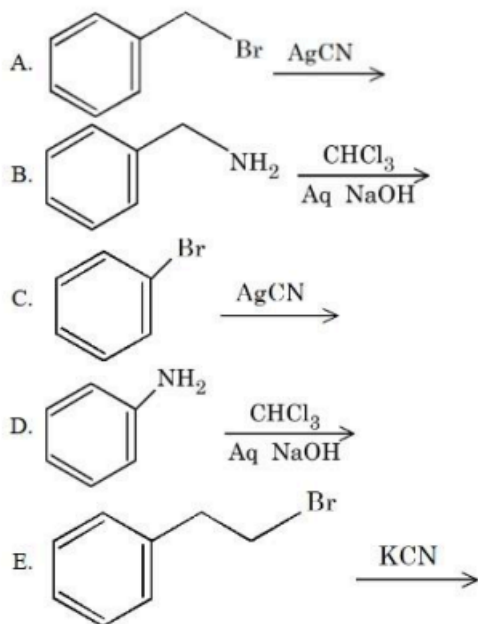
15. For the following Friedel Craft's alkylation reaction, which of the statements are correct?



- A. Major product is n-propyl benzene.
- B. iso-propyl carbocation intermediate is also generated.
- C. Multiple substitution is inevitable.
- D. Introducing electron-donating substituent on benzene will not produce any alkyl benzene.

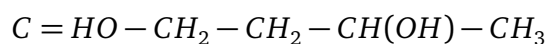
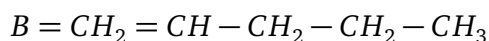
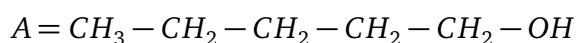
- (A) A and D only
- (B) B and C only
- (C) A and C only
- (D) B and D only

16. Benzyl isocyanide can be obtained from



- (A) A and B Only
 (B) A and C Only
 (C) B and D Only
 (D) D and E Only

17. Consider compounds A, B and C with following structural formulae



For the conversion of B from A, reagent (D) required is ____ and structural formula of product (E) obtained when C undergoes same reaction using excess reagent (D) is ____.

- (A)

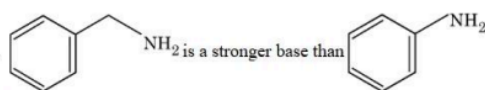
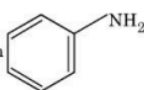
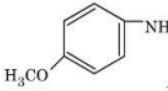
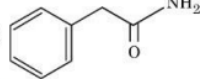
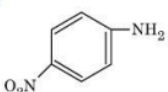
D	E
Conc. H_2SO_4	$\text{CH}_2 = \text{CH} - \text{CH}(\text{OH})\text{CH}_3$
- (B)

D	E
PCC	$\text{HO} - \text{CH}_2 - \text{CH}_2 - \text{CH} = \text{CH}_2$
- (C)

D	E
PCC	$\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$
- (D)

D	E
Conc. H_2SO_4 or H_3PO_4	$\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$

18. Identify the incorrect statements.

- A.  is a stronger base than 
- B.  can be synthesized by Gabriel phthalimide synthesis.
- C.  $\xrightarrow{\text{Br}_2, \text{NaOH}}$ primary aromatic amine
- D.  $\xrightarrow[\text{(ii) } \Delta]{\text{(i) NaNO}_2, \text{HCl}, 0^\circ\text{C}}$ product will dissolve in NaOH

- (A) A and D Only
 (B) A and C Only

- (C) B and C Only
(D) A and B Only
-

19. Identify the correct statements.

- A. Glucose exists in two anomeric forms.
B. Anomers of glucose differ in configuration at C-1 in cyclic hemiacetal structure.
C. Melting point of α -anomer of glucose is greater than β -anomer.
D. Specific rotation of α -anomer is $+19^\circ$ while for β -anomer is $+112^\circ$.
E. α and β anomers of glucose are prepared by crystallization of saturated glucose solution at 303 K and 371 K respectively.

- (A) A and B Only
(B) B and C Only
(C) A, B and D Only
(D) A, B and E Only
-

20. Given below are two statements:

Statement I: Sodium dichromate and potassium dichromate are classified as primary standards in titrimetric analysis.

Statement II: Phenolphthalein is a weak base, therefore it dissociates in acidic medium.

- (A) Both Statement I and Statement II are true
(B) Both Statement I and Statement II are false
(C) Statement I is true but Statement II is false
(D) Statement I is false but Statement II is true
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Chemistry Section - B

21. Consider the following species:

$BrF_5, XeF_5^-, BF_4^-, ICl_4^-, XeF_4, SF_4, NH_4^+, ClF_3, XeF_2, ICl_2^-$

Number of species having sp^3d hybridized central atom is ____.

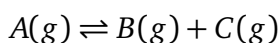
22. In an estimation of sulphur by Carius method 0.2 g of the substance gave 0.6 g of $BaSO_4$. The percentage of sulphur in the substance is ____ %.

(Given molar mass in $g\ mol^{-1}$ S : 32, $BaSO_4$: 231)

23. One mole of phenol is treated with dilute HNO_3 at 298 K to give a mixture of products. The mixture is separated by steam distillation. The steam volatile compound (X) is separated. The increase in percentage of oxygen in (X) with respect to phenol is ____ $\times 10^{-1}$ %.

(Given molar mass in $g\ mol^{-1}$ H:1, C:12, N:14, O:16)

24. The values of pressure equilibrium constant recorded at different temperatures for the following equilibrium reaction have been given below:



$\frac{1}{T} (K^{-1})$	$\log_{10} K_p$
0.05	3.5
0.06	2.5
0.07	1.5

The magnitude of $\frac{\Delta H^\circ}{R}$ calculated from the above data is _____. (Nearest integer)

25. If the half life of a first order reaction is 6.93 minutes then the time required for completion of 99% of the reaction will be ____ minutes.

(Given : $\log 2 = 0.3010$)
