

JEE Main 2024 Jan 31 Chemistry (Shift 2 Question Paper)

CHEMISTRY

Section-A

1. Match List I with List II:

List - I (Complex ion)	List - II (Electronic Configuration)
A. $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$	I. $t_{2g}^2 e_g^0$
B. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$	II. $t_{2g}^3 e_g^0$
C. $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$	III. $t_{2g}^6 e_g^2$
D. $[\text{V}(\text{H}_2\text{O})_6]^{3+}$	IV. $t_{2g}^2 e_g^2$

Choose the correct answer from the options given below:

- (1) A-III, B-II, C-IV, D-I
- (2) A-IV, B-I, C-II, D-III
- (3) A-IV, B-III, C-I, D-II
- (4) A-II, B-III, C-IV, D-I

2. A sample of CaCO_3 and MgCO_3 weighed 2.21 g is ignited to a constant weight of 1.152 g. The composition of the mixture is:

(Given molar masses: $\text{CaCO}_3 = 100$, $\text{MgCO}_3 = 84$)

- (1) 1.187 g CaCO_3 + 1.023 g MgCO_3
- (2) 1.023 g CaCO_3 + 1.023 g MgCO_3
- (3) 1.187 g CaCO_3 + 1.187 g MgCO_3
- (4) 1.023 g CaCO_3 + 1.187 g MgCO_3

3. Identify A and B in the following reaction sequence:

4. Given below are two statements:

Statement I: S_8 solid undergoes disproportionation under alkaline conditions to form S^{2-} and $\text{S}_2\text{O}_3^{2-}$.

Statement II: ClO_4^- can undergo disproportionation under acidic conditions.

Choose the correct answer:

- (1) Statement I is correct but Statement II is incorrect.
- (2) Statement I is incorrect but Statement II is correct.
- (3) Both statements are incorrect.

- (4) Both statements are correct.
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5. Identify the major product 'P' in the following reaction:

6. Major product of the reaction:

- (1) Isomer A
 - (2) Isomer B
 - (3) Isomer C
 - (4) Isomer D
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7. Identify the structure of 2,3-dibromo-1-phenylpentane.

8. Select the option with the correct property:

- (1) $[\text{Ni}(\text{CO})_4]$ and $[\text{NiCl}_4]^{2-}$ both diamagnetic
 - (2) $[\text{Ni}(\text{CO})_4]$ and $[\text{NiCl}_4]^{2-}$ both paramagnetic
 - (3) $[\text{NiCl}_4]^{2-}$ diamagnetic, $[\text{Ni}(\text{CO})_4]$ paramagnetic
 - (4) $[\text{Ni}(\text{CO})_4]$ diamagnetic, $[\text{NiCl}_4]^{2-}$ paramagnetic
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9. The azo-dye (Y) formed in the following reaction is:

10. Given below are two statements:

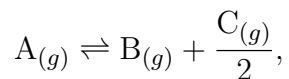
Statement I: Aniline reacts with conc. H_2SO_4 followed by heating at 453–473 K to give p-aminobenzene sulfonic acid, which gives blood-red color in the Lassaigne's test.

Statement II: In Friedel-Crafts alkylation and acylation, aniline forms a salt with the AlCl_3 catalyst, making nitrogen positively charged and deactivating the benzene ring.

Choose the correct answer:

- (1) Statement I is false but Statement II is true.
 - (2) Both statements are false.
 - (3) Statement I is true but Statement II is false.
 - (4) Both statements are true.
-

11. For the reaction:



the correct relationship between K_P , α , and equilibrium pressure P is:

- (1) $\frac{\alpha/2 P^{1/2}}{(2+\alpha)^{1/2}}$
- (2) $\frac{\alpha^{3/2} P^{1/2}}{(2+\alpha)^{1/2}(1-\alpha)}$
- (3) $\frac{\alpha/2 P^{3/2}}{(2+\alpha)^{3/2}}$
- (4) $\frac{\alpha/2 P^{1/2}}{(2+\alpha)^{3/2}}$

12. Choose the correct statements from the following:

- A. All group 16 elements form oxides of general formula EO_2 and EO_3 where $E = S, Se, Te,$ and Po . Both the types of oxides are acidic in nature.
- B. TeO_2 is an oxidizing agent, while SO_2 is reducing in nature.
- C. The reducing property decreases from H_2S to H_2Te down the group.
- D. The ozone molecule contains five lone pairs of electrons.

- (1) A and D only
- (2) B and C only
- (3) C and D only
- (4) A and B only

13. Identify the name reaction:

- (1) Stephen reaction
- (2) Etard reaction
- (3) Gattermann-Koch reaction
- (4) Rosenmund reduction

14. Which of the following is least ionic?

- (1) $BaCl_2$
- (2) $AgCl$
- (3) KCl
- (4) $CoCl_2$

15. The fragrance of flowers is due to the presence of steam-volatile organic

compounds called essential oils. These are generally insoluble in water at room temperature but are miscible with water vapor in the vapor phase. A suitable method for the extraction of these oils from the flowers is:

- (1) Crystallization
- (2) Distillation under reduced pressure
- (3) Distillation
- (4) Steam distillation

16. Given below are two statements:

Statement I: Group 13 trivalent halides get easily hydrolyzed by water due to their covalent nature.

Statement II: AlCl_3 , upon hydrolysis in acidified aqueous solution, forms octahedral $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ ion.

Choose the correct answer:

- (1) Statement I is true but Statement II is false.
- (2) Statement I is false but Statement II is true.
- (3) Both statements are false.
- (4) Both statements are true.

17. The four quantum numbers for the electron in the outermost orbital of potassium (atomic number 19) are:

- (1) $n = 4, l = 2, m = -1, s = +\frac{1}{2}$
- (2) $n = 4, l = 0, m = 0, s = +\frac{1}{2}$
- (3) $n = 3, l = 0, m = 1, s = +\frac{1}{2}$
- (4) $n = 2, l = 0, m = 0, s = +\frac{1}{2}$

18. Choose the correct statements:

- A. Mn_2O_7 is an oil at room temperature.
- B. V_2O_4 reacts with acid to give VO_2^{2+} .
- C. CrO is a basic oxide.
- D. V_2O_5 does not react with acid.

Choose the correct answer:

- (1) A, B, and D only.
 - (2) A and C only.
 - (3) A, B, and C only.
 - (4) B and C only.
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19. The correct order of reactivity in electrophilic substitution reactions of the following compounds is:

- (1) $B > C > A > D$
 - (2) $D > C > B > A$
 - (3) $A > B > C > D$
 - (4) $B > A > C > D$
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20. Consider the following elements in a group and period:

Which of the following is/are true?

- A. Order of atomic radii: $B' < A' < D' < C'$
- B. Order of metallic character: $B' < A' < D' < C'$
- C. Size of the element: $D' < C' < B' < A'$
- D. Order of ionic radii: $B'^+ < A'^+ < D'^+ < C'^+$

- (1) A only
 - (2) A, B, and D only
 - (3) A and B only
 - (4) B, C, and D only
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Section-B

21. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is 1 Å, then fractional charge on each atom is $\text{-----} \times 10^{-1}$ esu.

(Given: 1 D = 10^{-18} esu cm)

22. For the reaction $r = k[A]$, 50% of A is decomposed in 120 minutes. The time taken for 90% decomposition of A is ----- minutes.

23. A compound (X) with molar mass 108 g mol^{-1} undergoes acetylation to give a product with molar mass 192 g mol^{-1} . The number of amino groups in the compound (X) is ----- .

24. Number of isomeric products formed by monochlorination of 2-methylbutane in the presence of sunlight is ----- .

25. Number of moles of H^+ ions required by 1 mole of MnO_4^- to oxidize oxalate ion to CO_2 is ----- .

26. In the reaction of potassium dichromate, potassium chloride, and sulfuric acid (conc.), the oxidation state of the chromium in the product is (+)-----.

27. The molarity of 1L orthophosphoric acid (H_3PO_4) having 70% purity by weight (specific gravity 1.54 g cm^{-3}) is ----- M.
(Given: Molar mass of $H_3PO_4 = 98 \text{ g mol}^{-1}$)

28. The values of conductivity of some materials at 298.15 K in S m^{-1} are 2.1×10^3 , 1.0×10^{-16} , 1.2×10 , 3.9, 1.5×10^{-2} , 1×10^{-7} , and 1.0×10^3 . The number of conductors among the materials is -----.

29. From the vitamins A, B₁, B₆, B₁₂, C, D, E, and K, the number of vitamins that can be stored in our body is -----.

30. If 5 moles of an ideal gas expand from 10 L to 100 L at 300 K under isothermal and reversible conditions, then work $w = -x \text{ J}$. The value of x is -----.
(Given: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)
