

MASTER TESTING AGENCY
JEE (Main) — Chemistry
Full Syllabus Test | Set J | Session 2026-27

Time Allowed: 1 Hour

Maximum Marks: 100

General Instructions

- Section A: 20 multiple-choice questions, each with four options of which only one is correct.
- Section B: 5 numerical value questions; the answer is an integer. All questions in both sections are compulsory.
- Marking (as in the NTA scheme): +4 for a correct answer, -1 for an incorrect answer, 0 if unattempted — in both sections.
- Use of a calculator, log table or any electronic device is not permitted.
- This is an original practice paper written to the JEE (Main) pattern and the NTA syllabus; it is not a reproduction of any official paper.

SECTION A: MULTIPLE CHOICE (QUESTIONS 1-20)

- 1.0 g of oxalic acid dihydrate ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, $M = 126 \text{ g/mol}$) is dissolved in water to make 250 mL of solution. The volume of 0.1 M KMnO_4 (in acidic medium) needed to titrate 25 mL of this solution is
(a) 7.94 mL (b) 1.59 mL
(c) 3.17 mL (d) 15.9 mL
- The wavelength of the photon emitted when the electron of a hydrogen atom falls from $n = 4$ to $n = 2$ is ($R_H = 1.097 \times 10^7 \text{ m}^{-1}$)
(a) 656 nm (b) 434 nm
(c) 122 nm (d) 486 nm
- HF forms stronger hydrogen bonds than H_2O , yet water boils at a higher temperature because
(a) H-F bonds are weaker than O-H bonds
(b) HF is a non-polar molecule
(c) HF does not form hydrogen bonds
(d) each H_2O molecule takes part in about twice as many hydrogen bonds as each HF molecule
- The pair in which both quantities are state functions is
(a) enthalpy and Gibbs energy (b) enthalpy and work
(c) heat and work (d) heat and entropy
- A 5% (w/V) glucose solution is isotonic with an x% (w/V) urea solution at the same temperature. x is
(a) 1.67 (b) 3.0
(c) 15.0 (d) 5.0
- An acid-base indicator HIn has $\text{pK}_a = 9.3$. Its colour change is seen over the pH range of about
(a) 6.3 to 8.3 (b) 3.1 to 4.4
(c) 8.3 to 10.3 (d) 9.3 to 11.3
- The emf of the cell $\text{Zn} | \text{Zn}^{2+}(0.01 \text{ M}) || \text{Cu}^{2+}(1 \text{ M}) | \text{Cu}$ at 298 K is ($E^\circ_{\text{cell}} = 1.10 \text{ V}$)
(a) 1.041 V (b) 1.218 V
(c) 1.159 V (d) 1.10 V

8. The order of a reaction
 (a) always equals its molecularity
 (b) can be zero, fractional or a whole number
 (c) is always a whole number
 (d) is never zero
9. The correct order of the first ionisation enthalpies of Na, Mg, Al and Si is
 (a) $\text{Si} > \text{Al} > \text{Mg} > \text{Na}$
 (b) $\text{Mg} > \text{Si} > \text{Al} > \text{Na}$
 (c) $\text{Al} > \text{Si} > \text{Mg} > \text{Na}$
 (d) $\text{Si} > \text{Mg} > \text{Al} > \text{Na}$
10. The number of P-O-P bonds in a molecule of P_4O_{10} is
 (a) 4
 (b) 6
 (c) 5
 (d) 10
11. Misch metal, used in lighter flints, is an alloy of
 (a) a lanthanoid metal (about 95%) with iron (about 5%) and traces of S, C, Ca and Al
 (b) the actinoid metals
 (c) iron and carbon only
 (d) copper and zinc
12. The number of donor atoms in the ligand diethylenetriamine (dien) is
 (a) 2
 (b) 3
 (c) 6
 (d) 4
13. In Kjeldahl's method, the ammonia from 0.5 g of an organic compound exactly neutralised 10 mL of 1 M H_2SO_4 . The percentage of nitrogen in the compound is
 (a) 28%
 (b) 14%
 (c) 42%
 (d) 56%
14. The correct order of acid strength is
 (a) $\text{ClCH}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{C}_6\text{H}_5\text{OH} > \text{C}_2\text{H}_5\text{OH}$
 (b) $\text{CH}_3\text{COOH} > \text{ClCH}_2\text{COOH} > \text{C}_6\text{H}_5\text{OH} > \text{C}_2\text{H}_5\text{OH}$
 (c) $\text{ClCH}_2\text{COOH} > \text{C}_6\text{H}_5\text{OH} > \text{CH}_3\text{COOH} > \text{C}_2\text{H}_5\text{OH}$
 (d) $\text{C}_6\text{H}_5\text{OH} > \text{ClCH}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{C}_2\text{H}_5\text{OH}$
15. An alkene on ozonolysis gives a mixture of propanone and ethanal. The alkene is
 (a) 2-methylbut-2-ene
 (b) 2-methylbut-1-ene
 (c) pent-2-ene
 (d) 3-methylbut-1-ene
16. The compound that undergoes $\text{S}_{\text{N}}1$ hydrolysis most rapidly is
 (a) $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$
 (b) $(\text{C}_6\text{H}_5)_2\text{CHCl}$
 (c) $\text{CH}_3\text{CH}_2\text{Cl}$
 (d) CH_3Cl
17. The compound that does NOT give the iodoform test is
 (a) ethanol
 (b) pentan-3-one
 (c) propan-2-ol
 (d) acetophenone
18. Nitration of aniline with a mixture of conc. HNO_3 and conc. H_2SO_4 gives a substantial amount of m-nitroaniline because
 (a) the $-\text{NH}_2$ group itself is a meta-directing group
 (b) nitration proceeds by a free-radical mechanism
 (c) aniline is protonated to the meta-directing anilinium ion
 (d) hydrogen bonding blocks the ortho and para positions

19. The number of chiral carbon atoms in the open-chain form of D-glucose is
(a) 5 (b) 3
(c) 4 (d) 6
20. The pair of cations that can be separated by passing H_2S through their solution acidified with dilute HCl is
(a) Zn^{2+} and Ni^{2+} (b) Cu^{2+} and Pb^{2+}
(c) Ba^{2+} and Sr^{2+} (d) Cu^{2+} and Zn^{2+}

SECTION B: NUMERICAL VALUE (QUESTIONS 21-25)

21. Find the pH of the solution obtained by mixing 100 mL of 0.11 M HCl with 100 mL of 0.09 M NaOH at 25 °C. integer answer
22. Find the number of unpaired electrons in a chromium atom ($Z = 24$) in its ground state. integer answer
23. Find the total number of unpaired electrons in the complex ions $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Cr}(\text{NH}_3)_6]^{3+}$ taken together. integer answer
24. Find the number of structurally different monochloro derivatives (ignoring stereoisomers) formed when 2,2,4-trimethylpentane is chlorinated in diffused sunlight. integer answer
25. Find the number of σ bonds in a molecule of benzonitrile ($\text{C}_6\text{H}_5\text{CN}$). integer answer

MASTER TESTING AGENCY**Answer Key**

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SECTION A: MULTIPLE CHOICE

1.	(c) Moles of oxalic acid in 25 mL = $(1.0/126)/10 = 7.94 \times 10^{-4}$. 2MnO_4^- react with $5\text{C}_2\text{O}_4^{2-}$, so moles of $\text{KMnO}_4 = (2/5)(7.94 \times 10^{-4}) = 3.17 \times 10^{-4}$; $V = 3.17 \times 10^{-4}/0.1 \text{ L} = 3.17 \text{ mL}$.
2.	(d) $1/\lambda = R_H(1/2^2 - 1/4^2) = 1.097 \times 10^7 \times 3/16 = 2.06 \times 10^6 \text{ m}^{-1}$, so $\lambda = 486 \text{ nm}$ (the H- β line of the Balmer series).
3.	(d) H_2O has two H atoms and two lone pairs (up to four H bonds); HF has one H atom, so it forms only chains.
4.	(a) H and G depend only on the state; q and w depend on the path.
5.	(a) Equal molarities: $(5/180) = (x/60)$, so $x = 1.67$.
6.	(c) The eye sees the change for $[\text{In}^-]/[\text{HIn}]$ from 1/10 to 10, i.e. $\text{pH} = \text{pK}_a \pm 1$.
7.	(c) $E = 1.10 - (0.0591/2) \log(0.01/1) = 1.10 + 0.059 = 1.159 \text{ V}$.
8.	(b) Order is found by experiment and may be zero or fractional.
9.	(d) Ionisation enthalpy rises across the period, but Al ($3s^2 3p^1$) is below Mg ($3s^2$, fully filled s) because its 3p electron is more easily removed: Si (787) > Mg (738) > Al (578) > Na (496) kJ/mol.
10.	(b) In P_4O_{10} each P is bonded to three bridging O atoms and one terminal O; the six bridging O atoms lie along the six edges of the P_4 tetrahedron, giving 6 P-O-P bonds.
11.	(a) Misch metal is mostly a mixture of lanthanoid metals.
12.	(b) $\text{H}_2\text{N}-\text{CH}_2\text{CH}_2-\text{NH}-\text{CH}_2\text{CH}_2-\text{NH}_2$ binds through its three N atoms (tridentate).
13.	(d) Moles of $\text{H}_2\text{SO}_4 = 0.01$, so moles of $\text{NH}_3 = 0.02$ and mass of N = $0.02 \times 14 = 0.28 \text{ g}$. % N = $(0.28/0.5) \times 100 = 56\%$.
14.	(a) The -I effect of Cl stabilises the carboxylate, so chloroacetic acid (pK_a 2.9) is stronger than acetic acid (4.8); phenol (10, resonance-stabilised phenoxide) is stronger than ethanol (about 16).
15.	(a) Joining the carbonyl carbons of $(\text{CH}_3)_2\text{C}=\text{O}$ and CH_3CHO by a double bond gives $(\text{CH}_3)_2\text{C}=\text{CHCH}_3$, i.e. 2-methylbut-2-ene.
16.	(b) $\text{S}_\text{N}1$ rate depends on carbocation stability; the diphenylmethyl cation is stabilised by resonance with two benzene rings, more than the benzyl cation, while primary and methyl cations are unstable.
17.	(b) The iodoform test needs a $\text{CH}_3\text{CO}-$ group or a $\text{CH}_3\text{CH}(\text{OH})-$ group that can be oxidised to it. Pentan-3-one ($\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$) has neither.

18.	(c) In the strongly acidic nitrating mixture, much of the aniline is protonated to $\text{C}_6\text{H}_5\text{NH}_3^+$; the $-\text{NH}_3^+$ group is deactivating and meta-directing, so m-nitroaniline (about 47%) forms along with the o- and p-isomers.
19.	(c) In $\text{CHO}-(\text{CHOH})_4-\text{CH}_2\text{OH}$, C-2, C-3, C-4 and C-5 each carry four different groups; C-1 (CHO) and C-6 (CH_2OH) are not chiral.
20.	(d) In acidic medium the low S^{2-} concentration precipitates only the very insoluble group II sulphides (CuS); ZnS (group IV) needs ammoniacal medium. $\text{Zn}^{2+}/\text{Ni}^{2+}$ both stay in solution, $\text{Cu}^{2+}/\text{Pb}^{2+}$ both precipitate, and $\text{Ba}^{2+}/\text{Sr}^{2+}$ give no sulphide precipitate.

SECTION B: NUMERICAL VALUE

21.	2 Excess $\text{H}^+ = (0.11 - 0.09) \times 0.1 = 0.002$ mol in 0.2 L, so $[\text{H}^+] = 0.01$ M and $\text{pH} = 2$.
22.	6 Cr is $[\text{Ar}] 3\text{d}^5 4\text{s}^1$ (half-filled d subshell is extra stable), so all six electrons in 3d and 4s are unpaired.
23.	8 $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$: Co^{3+} is 3d^6 and, like almost all Co(III) complexes, is low spin ($t_2\text{g}^6$): 0 unpaired. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$: Fe^{3+} is 3d^5 and H_2O is a weak-field ligand, so it is high spin ($t_2\text{g}^3\text{e}_\text{g}^2$): 5 unpaired. $[\text{Cr}(\text{NH}_3)_6]^{3+}$: Cr^{3+} is 3d^3 ($t_2\text{g}^3$): 3 unpaired whatever the ligand. Total = $0 + 5 + 3 = 8$.
24.	4 $(\text{CH}_3)_3\text{C}-\text{CH}_2-\text{CH}(\text{CH}_3)_2$ has four sets of equivalent H atoms: the nine H of the three CH_3 groups on C-2, the CH_2 at C-3, the tertiary H at C-4 and the six H of the two CH_3 groups on C-4. They give 1-chloro-2,2,4-trimethylpentane, 3-chloro-2,2,4-trimethylpentane, 2-chloro-2,4,4-trimethylpentane and 1-chloro-2,4,4-trimethylpentane: 4 products.
25.	13 Ring: 6 C-C σ bonds and 5 C-H σ bonds. The bond from the ring to the CN carbon is 1 σ , and $\text{C}\equiv\text{N}$ has 1 σ and 2 π bonds. Total $\sigma = 6 + 5 + 1 + 1 = 13$ (the molecule also has $3 + 2 = 5$ π bonds).