ASSOCIATION OF CHEMISTRY TEACHERS

National Standard Examination in Chemistry – 2026

Date of Examination: November 22, 2026

Time: 11:30 AM to 1:30 PM

Question Paper Code: 31

Student's Roll No:											

Write the Question Paper Code (mentioned above) on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be evaluated. Note that the same Question Paper Code appears on each page of the Question Paper.

Instructions to Candidates:

1. Use of mobile phone, smart watch, iPad and devices like ear pod etc during exam is STRICTLY PROHIBITED
2. In addition to this Question Paper, you are given OMR Answer Sheet along with candidate's copy.
3. On the OMR sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
   Incomplete/ incorrect/ carelessly filled information may disqualify your candidature.
4. On the OMR Answer Sheet, use only **BLUE** or **BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your **Eleven-digit roll number and date of birth** entered on the OMR Answer Sheet shall remain your login credentials means login id and password respectively for accessing your performance / result in National Standard Examination in Chemistry – 2026.
   Question paper has two parts. In part A-1 (Q. No.1 to 48) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q.No.12 (a) (●) (c) (d)

In part A-2 (Q. No. 49 to 60) each question has four alternatives out of which any number of alternative(s) (1, 2, 3, or 4) may be correct. You have to choose **all** correct alternative(s) and fill the appropriate bubble(s), as shown

Q.No.52 (a) (●) (c) (●)

7. Attempt all sixty questions. For **Part A-1,** each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A-2,** you get 6 marks if all the correct alternatives are marked and no incorrect. No negative marks in this part.
8. Rough work may be done in the space provided. There are **20** printed pages in this question paper
9. Use of **non-programmable scientific** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting Answer Paper, take away the Question Paper & Candidate's copy of OMR sheet for your future reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the OMR Answer Sheet.

OMR Answer Sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED. Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK OF THE OMR ANSWER SHEET.

Instructions to Candidates (Continued) :
You may read the following instructions after submitting the Answer Sheet.

12. **Comments/Inquiries/Grievances regarding this Question Paper, if any, can be shared on the Inquiry/Grievance column on www.iapt.org.in on the specified format till Dec 1, 2026.**

13. **The answers/solutions to this Question Paper will be available on the website: www.iapt.org.in by Nov 29, 2026.** The score card may be downloaded after Dec 24, 2026

14. **CERTIFICATES and AWARDS:**
Following certificates shall be awarded by IAPT/ACT to students, successful in the National Standard Examination in Chemistry – 2026
(i) "CENTRE TOP 10 %" to be downloaded from iapt.org.in after 30.01.27
(ii) "STATE TOP 1 %" will be dispatched to the examinee
(iii) "NATIONAL TOP 1 %" will be dispatched to the examinee
(iv) "GOLD MEDAL & MERIT CERTIFICATE" to all students who attend OCSC – 2027 at HBCSE Mumbai
Certificate for centre toppers shall be uploaded on iapt.org.in

15. List of students (with centre number and roll number only) having a score equal and above **Minimum Admissible Score (MAS)** will be displayed on the website: **www.iapt.org.in** by **Dec 25, 2026. See the MAS clause** on the student's brochure on the web.

16. List of students eligible to appear for Indian National Chemistry Olympiad (INChO – 2027) shall be displayed on **www.iapt.org.in** by Dec 30, 2026.

Useful constants

Charge of electron, $e = 1.602 \times 10^{-19}\,C$

Mass of electron, $m_e = 9.1 \times 10^{-31}\,kg$

Planck's constant, $h = 6.63 \times 10^{-34}\,Js$

Speed of light, $c = 3.0 \times 10^{8}\,ms^{-1}$

Avogadro constant, $N_A = 6.022 \times 10^{23}\,mol^{-1}$

Faraday constant $F = 96500\,C\,mol^{-1}$

Molar gas constant, $R = 0.082\,L\,atm\,mol^{-1}\,K^{-1}$

$= 8.314\,J\,mol^{-1}\,K^{-1}$

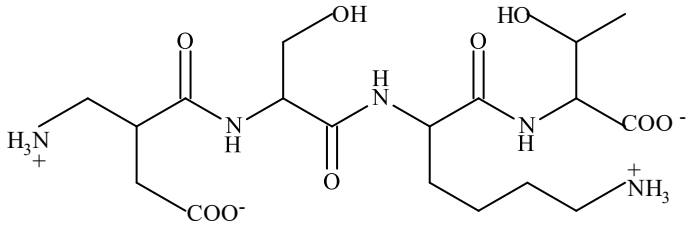
ASSOCIATION OF CHEMISTRY TEACHERS
NATIONAL STANDARD EXAMINATION IN CHEMISTRY
(NSEC - 2026)

Time: 120 minute **Max. Marks: 216**

Attempt All Sixty Questions

A – 1
ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.

1. The correct sequence of amino acids in the following given tetrapeptide is



(a) Asp, Lys, Ser, Thr (b) Ser, Lys, Thr, Asp
(c) Asp, Ser, Lys, Thr (d) Ser, Thr, Lys, Asp

2. Mn^{2+} reacts with sodium bismuthate in acidic medium to a dark-coloured diamagnetic compound (A) which on heating at 513K gives another dark-coloured paramagnetic compound (B). Also, compound (A) reacts with thiosulphate ions to form a brown coloured, water insoluble compound (C). Identify compounds (A), (B) and (C)
   (a) Compound A = $KMnO_4$, B = K_2MnO_4 and C = MnO_2
   (b) Compound A = K_2MnO_4, B = $KMnO_4$ and C = Mn_2O_3
   (c) Compound A = Mn_2O_3, B = K_2MnO_4 and C = Mn_3O_4
   (d) Compound A = $KMnO_4$, B = Mn_3O_4 and C = MnO_2

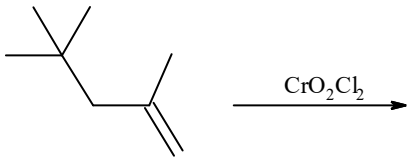
3. The rate law for the gas phase reaction between 'A' and 'B' is given as rate $= k[A]^2[B]$. If in another experiment, [A] is reduced to one-third of its previous value, what change must be made to [B] so that the reaction rate becomes one-third of its initial value?
   (a) Decrease B to one-third of its original value (b) Keep B unchanged
   (c) Increase B to 3 times its original value (d) Increase B by a factor of 9

4. Bis(benzoylacetonato)beryllium(II) exists in two isomeric forms. Which of the following statement is correct?
   (a) It is a square planar complex with a plane of symmetry.
   (b) It is a tetrahedral complex with no plane of symmetry and the two forms are not superimposable on each other.
   (c) It is a tetrahedral complex with a plane of symmetry and two forms are not superimposable on each other.
   (d) It is an octahedral complex with a plane of symmetry.

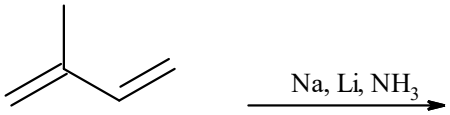
5. The ease of hydrolysis of borazine compared to benzene is mainly due to the:
   (a) stronger π -bonding in borazine (b) polar B-N bonds
   (c) higher symmetry of borazine (d) absence of lone pair of electrons

6. Examine the reaction/s **I, II, III** and **IV** given below.

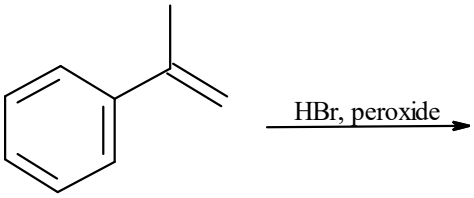
I



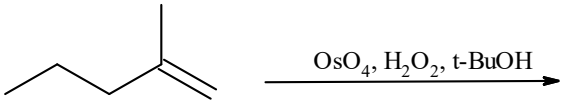
II



III



IV



The reaction(s) that will produce chiral product(s) is/are:

(a) I & III (b) II & III (c) I & IV (d) Only IV

7. The correct option of intensive and extensive properties among the following are

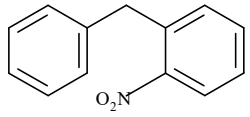
	Property	I	II	III	IV
i	EMF	Intensive	Extensive	Intensive	Intensive
ii	ΔU	Extensive	Extensive	Extensive	Extensive
iii	Viscosity	Intensive	Intensive	Extensive	Extensive
iv	Specific surface area	Intensive	Extensive	Intensive	Extensive

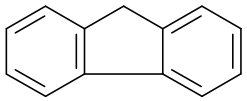
(a) II (b) III (c) I (d) IV

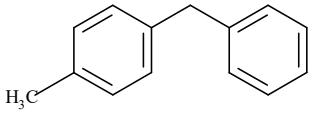
8. A mixture of compounds A and B is present in a test tube. Fumes are seen when exposed to moist air. When a rod dipped in ammonium hydroxide is brought near the mouth of this test tube, the intensity of the fumes increases. On the addition of concentrated sulphuric acid, brown fumes are obtained which intensifies on the addition of copper turnings. A solution of the mixture in an HCl medium gives a black precipitate on passing H_2S, which does not dissolve in yellow ammonium sulphide. When the acid solution is diluted to a large extent, a white turbidity is obtained which disappears on the addition of a few drops of HCl. The acidic solution obtained after removing the black precipitate gives a white precipitate on the addition of ammonium hydroxide. The precipitate is soluble in NaOH. Identify the cations and anions in solution.

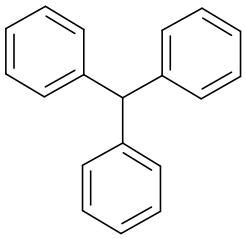
(a) Hg^{2+}, Cr^{3+}, NO_3^-, Br^-
(b) Mn^{2+}, Fe^{3+}, NO_2^-, Cl^-
(c) Cr^{3+}, Cu^{2+}, Br^-, Cl^-
(d) Bi^{3+}, Al^{3+}, NO_3^-, Cl^-

9. Compounds **I, II, III** and **IV**. On treating with a base, the compound that will give most stable carbanion is:

(a) 

(b) 

(c) 

(d) 

10. An aqueous solution of ferrous alum and chrome alum is heated with excess sodium peroxide. The products obtained are
    (a) Green precipitate and colourless supernatant
    (b) Brown precipitate and yellow supernatant
    (c) Brown precipitate and colourless supernatant
    (d) Green precipitate and yellow supernatant

11. Rank the following oxides in order of decreasing acidity in aqueous medium: Ga_2O_3, Al_2O_3, In_2O_3, Tl_2O, and B_2O_3.
    (a) $Tl_2O > In_2O_3 > Ga_2O_3 > Al_2O_3 > B_2O_3$
    (b) $Tl_2O > B_2O_3 > Al_2O_3 > In_2O_3 > Ga_2O_3$
    (c) $Ga_2O_3 > In_2O_3 > Al_2O_3 > B_2O_3 > Tl_2O$
    (d) $B_2O_3 > Al_2O_3 > Ga_2O_3 > In_2O_3 > Tl_2O$

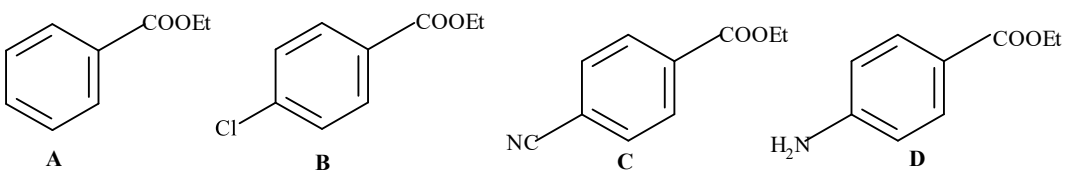
12. Which of the following is correct for the physisorption of N_2 on activated carbon at 77 K
    (a) $\Delta H = 0$; $\Delta S < 0$ (b) $\Delta H < 0$; $\Delta S < 0$ (c) $\Delta H > 0$; $\Delta S < 0$ (d) $\Delta H = 0$; $\Delta S = 0$

13. Consider the following statements regarding group 14 and 15 elements:
    (i) Sn^{2+} is more stable than Sn^{4+} due to the inert pair effect
    (ii) PbO_2 is a strong oxidizing agent, whereas SnO_2 is not
    (iii) BiH_3 is less stable than NH_3 due to decreasing E–H bond strength down the group
    (iv) Acidic character of oxides increases down group 14 due to increasing metallic character

    Which of the above statements are correct?

    (a) i and ii only (b) ii and iii only (c) i, ii and iii only (d) i, iii and iv only

14. Base catalyzed hydrolysis of esters is an irreversible reaction that involves nucleophilic addition followed by elimination of the alkoxide anion to give a carboxylic acid on acidic workup of the reaction.
    The following esters; **A, B, C** and **D** are subjected to alkaline hydrolysis.



A **B** **C** **D**

    The highest and the lowest rate of hydrolysis of the above esters respectively are:
    (a) A and D (b) B and D (c) C and D (d) B and C

15. Which of the following pair of complex ions has the longest and the shortest C−C bond, respectively?
    (a) $K[Pt(Cl)_3(\pi\text{-}F_2C{=}CF_2)]$ and $K[Pt(Cl)_3(\pi\text{-}H_2C{=}CH_2)]$
    (b) $K[Pt(Cl)_3(\pi\text{-}(CH_3)_2C{=}C(CH_3)_2)]$ and $K[Pt(Cl)_3(\pi\text{-}F_2C{=}CF_2)]$
    (c) $K[Pt(Cl)_3(\pi\text{-}Cl_2C{=}CCl_2)]$ and $K[Pt(Cl)_3(\pi\text{-}F_2C{=}CF_2)]$
    (d) $K[Pt(Cl)_3(\pi\text{-}(NC)_2C{=}C(CN)_2)]$ and $K[Pt(Cl)_3(\pi\text{-}(CH_3)_2C{=}C(CH_3)_2)]$

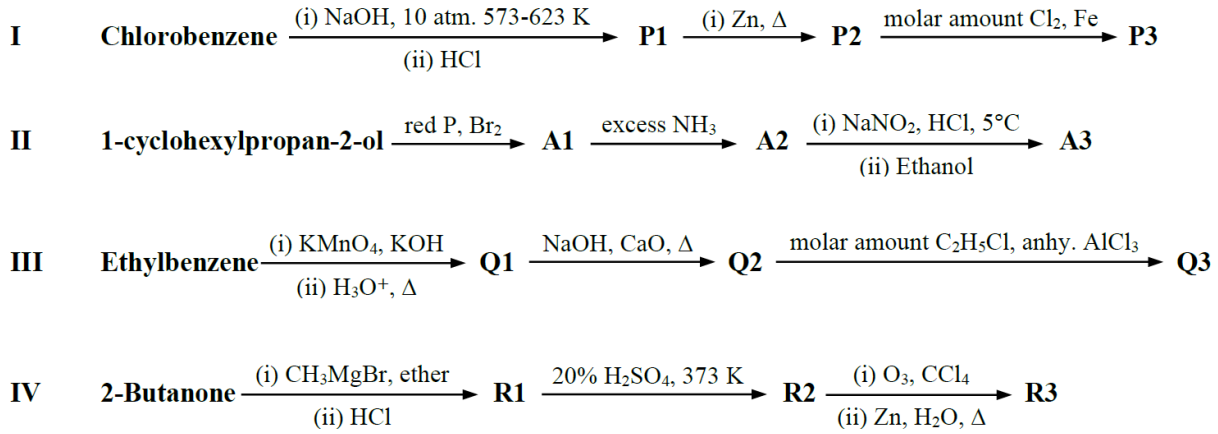
16. Bond dissociation enthalpies of H_2, Br_2 and HBr are 436, 192 and 366 kJ mol^{-1} respectively. Enthalpy of formation of HBr is
    (a) − 104 kJ mol^{-1} (b) 104 kJ mol^{-1} (c) 52 kJ mol^{-1} (d) − 52 kJ mol^{-1}

17. Consider the following statements:
    A. Fe^{3+} forms more stable complexes than La^{3+} with any given σ-donating ligand due to higher charge density.
    B. Lanthanoid ions generally form complexes with lower coordination numbers than transition metal ions.
    C. The stability of complexes of 5d elements is generally greater than their 3d analogues partly due to lanthanoid contraction.
    D. EDTA is a tetradentate ligand and forms stable complexes with many transition metals and other cations

    Identify the correct statements:
    (a) A and C only (b) A and B only (c) B only (d) C and D only

18. 0.9 % (w/v) of saline is isotonic with human blood. For a certain application the osmotic pressure of the same saline solution is required to be decreased by 25 %. The osmotic pressure of 1.5 L of saline solution prepared for this purpose is close to
    (a) 5.96 bar (b) 7.94 bar (c) 8.94 bar (d) 2.67 bar

19. Examine the reaction series **I, II, III** and **IV.**



The series of reactions amongst the above that regenerates the starting compound at the end will be:
(a) I and II (b) I and III (c) III and IV (d) I, II, III and IV

20. Identify the incorrect statement(s)
    A. Complete hydrolysis of XeF_4 and XeF_6 gives XeO_3.
    B. XeO_3 reacts with aqueous alkali to form hydrogen xenate ion, $HXeO_4^-$, which slowly disproportionate to give Xe and perxenate ion, XeO_6^{4-}.
    C. The perxenate solutions are yellow in colour and are strong reducing agents.
    D. XeF_4 and XeF_6 are square planar (dsp^2) and distorted octahedral (sp^3d^2) in shape, respectively.

    Choose the option:
    (a) A only (b) A and B (c) C and D (d) B, C and D

21. In Dumas method of estimation of nitrogen, 0.35 g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound is:
    (Aqueous tension at 300 K = 15 mm)
    (a) 15.45 % (b) 16.45% (c) 17.45% (d) 14.45%

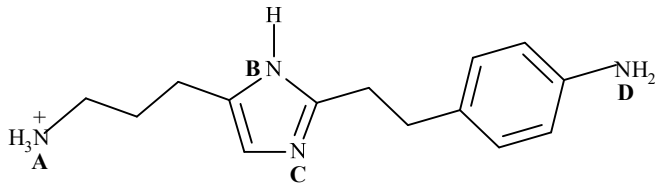
22. Identify the incorrect statement among the following:
    (a) Among halogens, F_2 does not undergo disproportionation reactions.
    (b) The correct order of stability is: HOCl > HOBr > HOI > HOF
    (c) The correct order of acidity is: $HOClO_3$ > $HOClO_2$ > HOClO > HOCl
    (d) The interhalogens AB_n undergo hydrolysis giving halide ions derived from the larger halogen and a hypohalite (when AB), halite (when AB_3), halate (when AB_5) and perhalate (when AB_7) anion derived from the smaller halogen. (A = larger halogen, B = Smaller halogen).

23. Acetylene (C_2H_2) gas is generated when water is added to CaC_2 (calcium carbide). The mass of CaC_2 (97% pure) required to generate the gas to be stored in 50L cylinder at 27 °C and 101.3 kPa is _____
    [Given: C = 12 g/mol and Ca = 40 g/mol]
    (a) 63 g (b) 134 g (c) 32 g (d) 99 g

24. Which of the following statement(s) is/are correct?
    A. The oxidation states of S in Caro's acid and thiosulphate ion are +6 and +2, respectively.
    B. In dithionic acid, there are four S=O, two S-OH groups and one S-S bond.
    C. The SF_2 is angular, SF_4 is tetrahedral and SF_6 is octahedral in shape.
    D. S is present in methionine and serine amino acids.

    Choose the correct option:
    (a) A only (b) A and B (c) C and D (d) B, C and D

25. The order of decreasing basic strength of the nitrogen atoms labelled as **A, B, C** and **D** in the following molecule is:



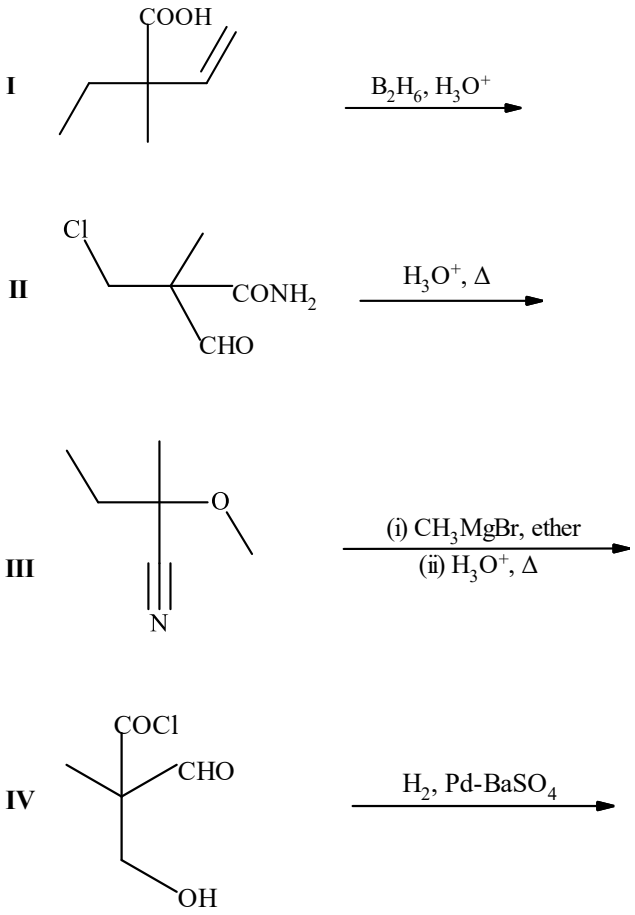
(a) B > C > D > A (b) C > D > B > A (c) B > D > A > C (d) C > A > B > D

26. Consider the following statements about the halides of phosphorous.
    A. PF_5, a colourless gas, is molecular and stereochemically non-rigid molecule and shows 'pseudorotation'.
    B. PCl_5 is molecular in gas phase but ionic in the solid phase, $[PCl_4]^+ [PCl_6]^-$
    C. Both PBr_5 and PI_5 are ionic in solid phase and exists as $[PBr_4]^+ [Br]^-$ and $[PI_4]^+ [I]^-$ respectively.
    D. The mixed chlorofluorides, PCl_4F and PCl_3F_2 have F atoms in axial position(s).

    Choose the correct option having all correct statements

    (a) C and D (b) A, C and D (c) A, B and D (d) A, B, C and D

27. Examine the following reactions



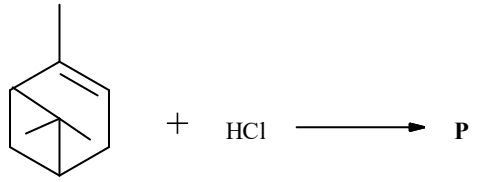
    The reaction(s) in which an achiral product is/are obtained

    (a) II and IV (b) I only (c) I, III and IV (d) IV only

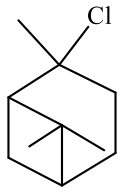
28. $Co^{2+}(aq)$ is pink in colour. When excess of HCl solution is added to its aqueous solution it becomes deep blue. The reason is
    (a) Octahedral $[Co(H_2O)_6]^{2+}$ changed to tetrahedral $[CoCl_4]^{2-}$
    (b) Octahedral $[Co(H_2O)_6]^{2+}$ changed to octahedral $[CoCl_6]^{4-}$
    (c) Octahedral $[Co(H_2O)_6]^{2+}$ changed to octahedral $[Co(H_2O)_6]^{3+}$
    (d) High spin octahedral $[Co(H_2O)_6]^{2+}$ changed to low spin octahedral $[Co(H_2O)_6]^{2+}$

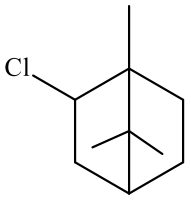
29. Surface tension
    (a) is an extensive property
    (b) is numerically equal to surface energy
    (c) has the units N m^{-2}
    (d) is independent of intermolecular forces

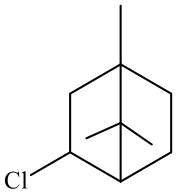
30. A carbocation intermediate is formed during dehydrohalogenation, and the intermediate is capable of structural rearrangements to give a more stable product. In the following reaction identify the product P.

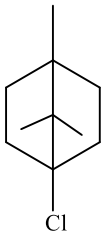


The product **P** is:

(a) 

(b) 

(c) 

(d) 

31. A Student sets up a galvanic cell as shown below and records its EMF as 0.71V.
(-) Mg (s) | $MgSO_4$ (1M aq.) || $Al_2(SO_4)_3$(1M aq.) | Al (s) (+)
While working with the cell, she accidently dropped some amount of $MgSO_4$ into the magnesium half-cell which readily dissolved. This caused EMF of the cell change to 0.698V. The quantity of $MgSO_4$ in g that fell into the Magnesium half-cell is closer to
[Given: E^0 Al = - 1.66 V and E^0 Mg = -2.37 V]
(a) 9.30 (b) 15.30 (c) 6.02 (d) 3.12

32. The structure of XeF_5^- does not resemble with:
A. Pentaiodide ion
B. Bromine pentafluoride
C. Iron pentacarbonyl
D. PCl_3F_2 (Both F are at axial positions)

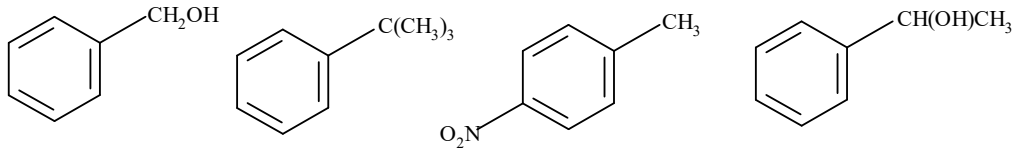
Choose the correct option:

(a) A (b) A and C (c) B, C and D (d) A, B, C and D

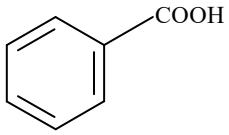
33. A solution containing 0.319 g of $CrCl_3.6H_2O$ was passed through a cation exchange resin and the liberated acid was titrated with a standard solution of NaOH. The neutralization required 19.0 mL of 0.125 N NaOH. Choose the correct structural formula of Cr(III) complex. (Molar mass of $CrCl_3.6H_2O$ = 266.35 g/mol)
(a) $[Cr(H_2O)_5Cl]Cl_2.H_2O$ (b) $[Cr(H_2O)_4Cl_2]Cl.2H_2O$
(c) $[Cr(H_2O)_3Cl_3].3H_2O$ (d) $[Cr(H_2O)_6]Cl_3$

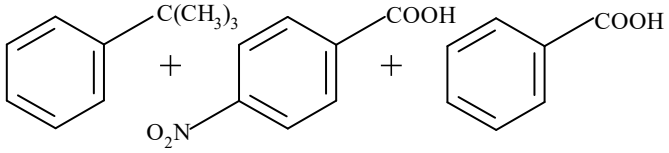
34. The precipitate is formed when 20 mL of an aqueous solution of KI (1% (w/v) is mixed with 20 mL of an aqueous solution of 1.5% (w/v) Pb $(NO_3)_2$ solution. The number of anions present in the mixed solution are _____
(a) 4.0×10^{19} I^- ions (b) 8.0×10^{19} NO_3^- ions
(c) 1.412×10^{20} I^- and 1.412×10^{20} NO_3^- ions (d) 3.65×10^{20} NO_3^- ions

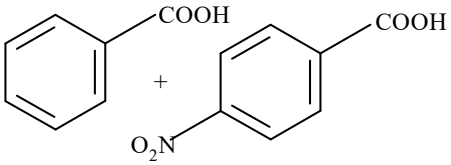
35. A mixture of the following organic compounds is oxidized using hot chromic acid.

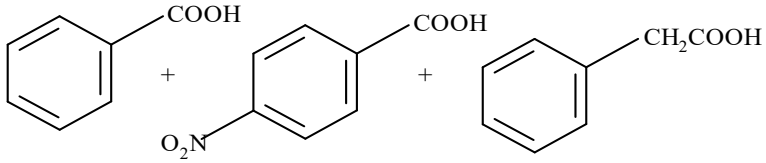


The reaction mixture contains:

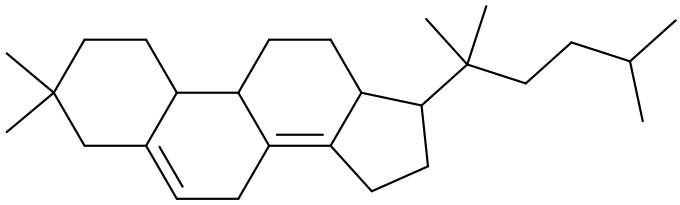
(a) only 

(b) 

(c) 

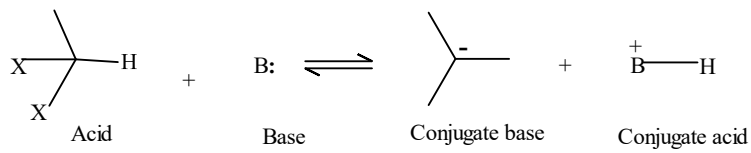
(d) 

36. How many chiral centers are present in the following structure?



(a) 4 (b) 10 (c) 6 (d) 8

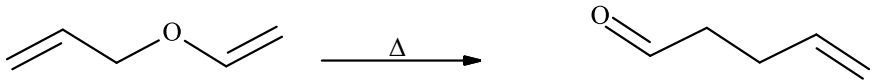
37. Consider the following reaction:



The acid in the above representation is known as a **carbon acid** where **X** is an electron withdrawing group. The most 'acidic' carbon acid amongst the following is:

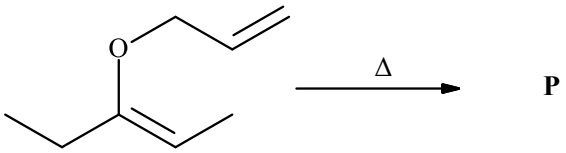
(a) 3-hexanone (b) 2,3-hexandione (c) 2,5-hexandione (d) 2,4-hexandione

38. Claisen rearrangement is a chemical reaction which involves heating of an allyl vinyl ether to form a 1,4-enone. There is an intramolecular rearrangement of the π system where a σ bond is broken and reformed in a different position in the product. A simple illustration is shown below:



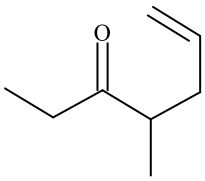
allyl vinyl ether — unsaturated carbonyl compound

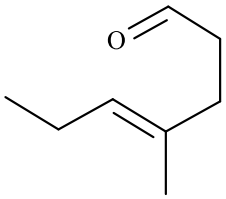
Consider the following reaction and identify the structure of **P**, which readily forms the product.

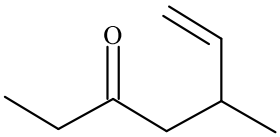


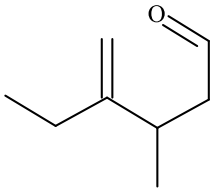
P

The product **P** is:

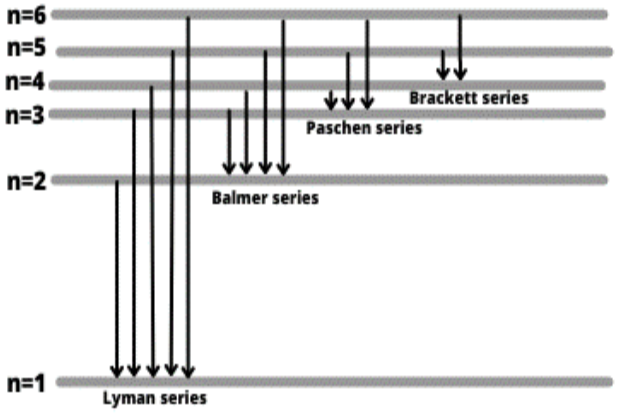
(a)


(b)


(c)


(d)


39. The line spectrum of hydrogen atom is shown below. Identify the statement that is correct *(Diagram is for representative purpose only and not to scale)*



Energy transitions for the Hydrogen Atom

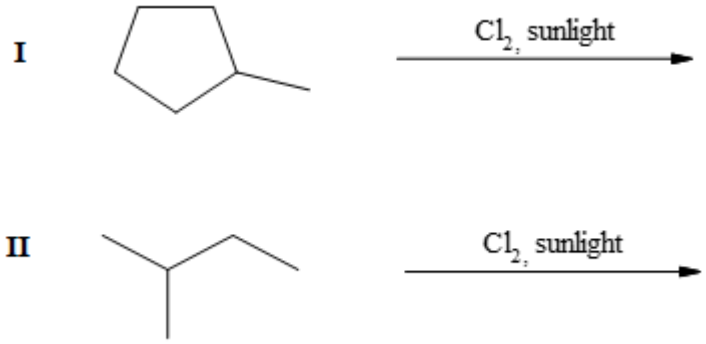
(a) First line of the Lyman series (n = 2 → 1) for hydrogen atom has the same wavelength as the first line of the Balmer series (n = 3 → 2) for the He^{+} ion.

(b) First Balmer line (n = 3 → 2) in hydrogen has the same wavelength as the transition from line (n = 6 → 4) in the second line of the Brackett series.

(c) The first line of the Paschen series of hydrogen atom has the same wavelength as the first line of the Balmer series of Li^{+2} ion.

(d) The first line of the Lyman series (n = 2 → 1) of Li^{+2} ion has the same wavelength as the third line (n = 5 → 2) of the Balmer series of He^{+} ion.

40. The total number of monochlorinated products (including the stereoisomers) in the following reactions **I** and **II** are respectively:



(a) 5, 5 (b) 10, 5 (c) 6, 5 (d) 8, 4

41. For the following stoichiometric oxidation of NO by O_2

$$2NO\ (g) + O_2\ (g) \rightarrow 2NO_2\ (g)$$

Experimental kinetic data obtained is given in the following table

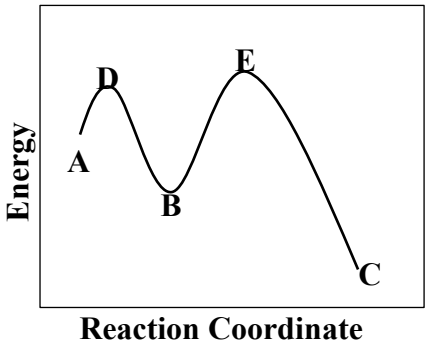
NO /mol dm^{-3}	O_2/ mol dm^{-3}	Initial rate / mol $dm^{-3}s^{-1}$
0.0200	0.0200	7.11×10^{-5}
0.0400	0.0200	2.8×10^{-4}
0.0200	0.0400	1.41×10^{-4}

The rate law that can be deduced form the kinetic data is

(a) $-\ d[NO_2]/dt = k\ [NO]^2\ [O_2]$ (b) $\frac{1}{2}\ d[NO_2]/dt = k\ [NO]^2\ [O_2]$

(c) $\frac{1}{2}\ d[NO_2]/dt = k\ [NO]\ [O_2]^2$ (d) $d[NO]/dt = k\ [NO]^2\ [O_2]$

42. The given energy profile diagram corresponds to the reaction A→B→C, Activation energies and the rate constants for the reaction I; A→B and for II; B→C are E_1 and k_1 and E_2 and k_2, respectively.



The correct statement among the following is:

(a) Reaction I is rate determining

(b) $k_1 > k_2$

(c) $(E_1 + E_2)$ is the activation energy for the reaction C→A.

(d) D is an intermediate and E is a transition state.

43. Choose the correct option of spontaneous and non-spontaneous processes in the following table

Process	(a)	(b)	(c)	(d)
Radioactive decay	spontaneous	Non-spontaneous	spontaneous	Non-spontaneous
Freezing water above 0 °C	Non-spontaneous	Non-spontaneous	spontaneous	Non-spontaneous
Adsorption of nitrogen on activated charcoal	spontaneous	spontaneous	spontaneous	spontaneous
Burning of coal	Spontaneous	spontaneous	Non spontaneous	spontaneous
Evaporation of water at 25 °C	Non-spontaneous	Non-spontaneous	Non-spontaneous	spontaneous

44. Most of the biochemical reactions are enzyme catalyzed. The mechanism of an enzyme catalyzed reaction can be written as follows

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \underset{k_{-2}}{\overset{k_2}{\rightleftharpoons}} E + P$$

Where E and S stands for Enzyme and Substrate, while k_1, k_2, k_{-1} and k_{-2} represent rate constants at the respective steps as shown in the mechanism. The concentration of ES, assuming initial concentration of Enzyme is $[E]_0$ is given by the equation

$$[ES] = \frac{[E]_0[S]}{\frac{k_{-1}+k_2}{k_1} + [S]} = \frac{[E]_0[S]}{K_m + [S]}$$

Which of the following statement is correct with respect to above expression?

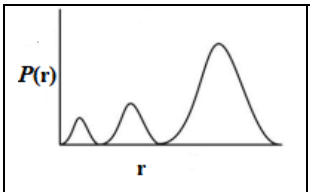
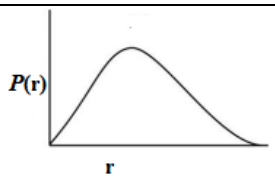
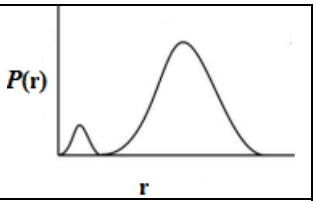
(a) When $K_m > [S]$, then the reaction is zero order with respect to substrate

(b) When $K_m = [S]$, it offers lowest possible rate for the enzymatic reaction

(c) K_m has the unit of concentration

(d) When $[S] > K_m$, reaction is first order with respect to substrate

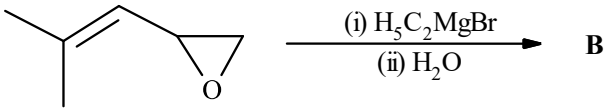
45. A rough sketch of the variation in the radial probability **P(r)** as function of distance **r** from center of nucleus are represented below.

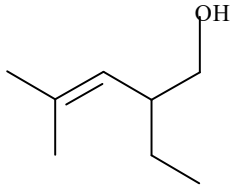
		
A	**B**	**C**

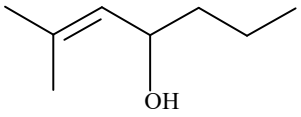
The correct orbital to which they can be associated is

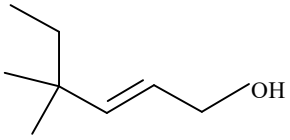
	A	**B**	**C**
(a)	2p	3s	3d
(b)	3s	3d	4s
(c)	3s	2p	2s
(d)	3p	3d	3s

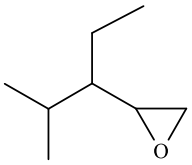
46. Product **B** in the following reaction is:



(a) 

(b) 

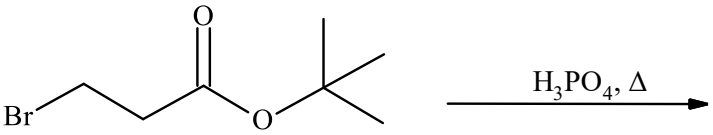
(c) 

(d) 

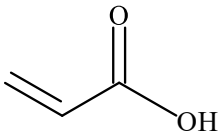
47. A human brain typically operates at 25W (1W = 1 J/s). The mass of glucose that must be consumed to sustain brain activity for 1h is _____.
(Assuming the energy comes from the following reaction)
$C_6H_{12}O_6 + O_2 \rightarrow 6CO_2 + 6H_2O + \Delta U$
Given that at 25 °C the energy of the reaction is ΔU = 2828 kJ/mol. Molar mass of glucose = 180g/mol

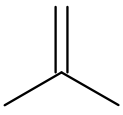
(a) 5.73 g (b) 1.59 mg (c) 5.73 kg (d) 1.59 g

48. The following reaction was carried out.

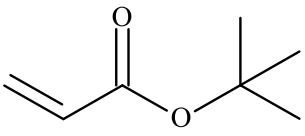


On investigation it was found that multiple products were obtained. One of the products decolourized bromine water. This particular product is:

(a) 

(b) 

(c) 

(d) 

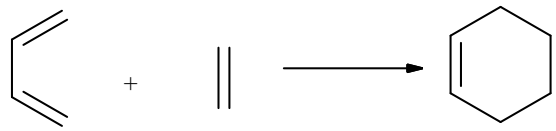
A – 2

ANY NUMBER OF OPTIONS (4, 3, 2 or 1) MAY BE CORRECT

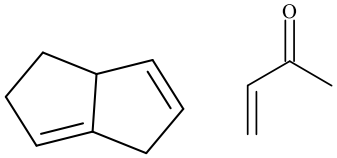
MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED AND NO INCORRECT.

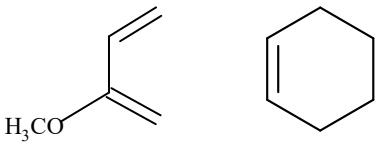
49. When equal volumes of 0.02 M $AgNO_3$ and 0.02 M NaCl are mixed, AgCl precipitates out (K_{sp} of AgCl at 298 K = 1.8×10^{-10}), which of the following statement(s) is/are true?
    (a) The addition of ammonium hydroxide to the mixture will cause the precipitate to redissolve due to the formation of a soluble complex ion.
    (b) If the temperature is increased, the K_{sp} of AgCl increases, causing more precipitate to dissolve.
    (c) The solubility of AgCl in 0.01 M NaCl will be higher than its solubility in pure water.
    (d) If the initial concentration of both reactants is lowered to 0.00002 M, no precipitation will occur.

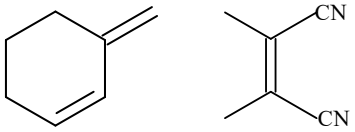
50. A conjugated diene and an unsaturated compound can undergo a thermal cycloaddition to cyclohexene even on mere heating to 50 °C. A simple example is shown below.

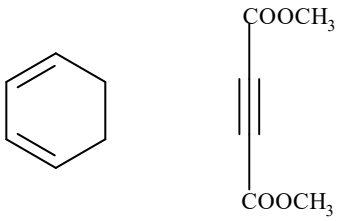


Presence of electron releasing groups on the diene and electron withdrawing groups on the unsaturated compound favour the formation of the cyclohexene derivative. From the following combinations, mark the option (s) of the diene and unsaturated compound that can react favorably to form the cyclic system.

(a) 

(b) 

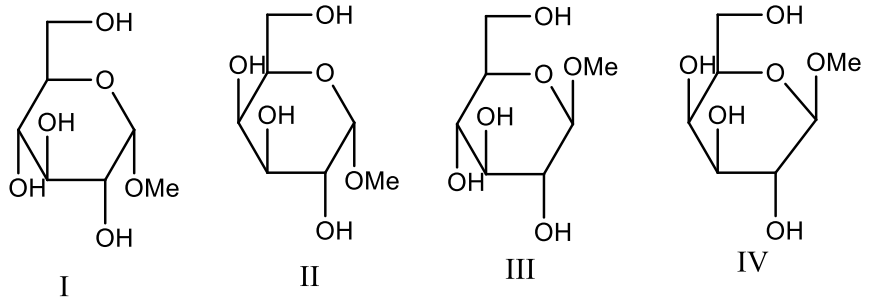
(c) 

(d) 

51. Resonance in the covalent molecules brings out the following changes. Which of the following statements are correct?
    (a) In a canonical structure the bond lengths become identical and lie between single bond and double bond.
    (b) The hybridization of the central atom changes between different canonical structures.
    (c) The resonance hybrid has lower energy than normal covalent molecule.
    (d) Resonance forces the combining atoms into a planar arrangement to allow π-electron delocalization.

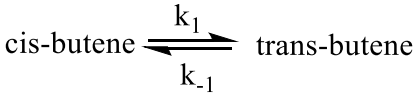
52. Identify the correct statements about the complexes "A" and "B" among $[CoCl(NH_3)_5]^{2+}$, $[Co(NH_3)_5(H_2O)]^{3+}$, $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$, $[Cu(H_2O)_4]^{2+}$, $[Cu(NH_3)_4]^{2+}$, $[Ti(H_2O)_6]^{3+}$, which absorb light at highest and lowest wavelengths, respectively.
    (a) A has a square planar geometry
    (b) B has an octahedral geometry
    (c) A is paramagnetic, and B is diamagnetic
    (d) Both A and B do not exhibit geometrical isomerism

53. Identify the correct set of stereochemical relationship amongst the following monomethyl monosaccharides labelled as **I** to **IV.**



    (a) I and II are anomers; I and III are epimers
    (b) I and II are epimers; III and IV are epimers
    (c) I and III are anomers; II and IV are anomers
    (d) II and III are epimers; I and IV are anomers

54. The equilibrium constants of the following isomerisation reaction at 400 K and 298 K are 2.07 and 3.42 respectively.



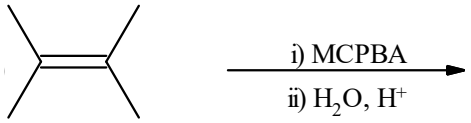
Which of the following is/are correct?

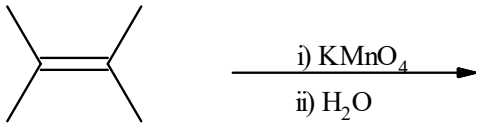
I. The forward reaction is exothermic
II. The forward reaction is endothermic
III. At both 400 K and 298 K, 50 % of cis-butene and 50 % of trans-butene are present at equilibrium
IV. At both 298 K and 400 K, $k_1 = k_{-1}$
V. The forward reaction is thermodynamically favoured at lower temperatures.

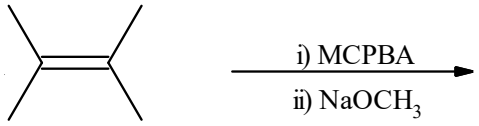
(a) I, IV and V (b) I and V (c) II and III (d) I, II, III and V

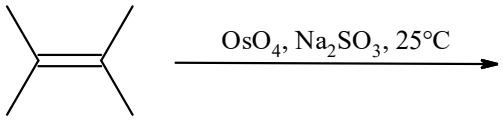
55. Identify the correct statements about Ellingham diagram from the following. Choose the correct answer from the following options
    (a) The curve for most of the reactions of formation of metal oxide $M_xO(s)$ has positive slope.
    (b) The change in phase is indicated by straight line and upward slope
    (c) Ellingham diagram can be used to explain the difficulties involved in the reduction of metal sulphides
    (d) The values of ΔH and ΔS remain nearly constant even on varying the temperature

56. The reactions that will form vicinal diols as products from the following, are:

(a) 

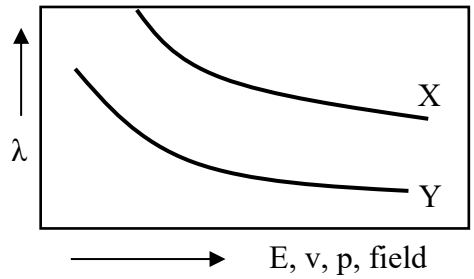
(b) 

(c) 

(d) 

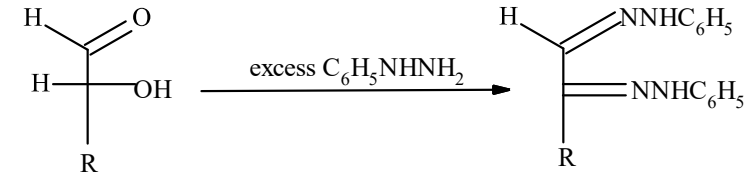
57. Which of the following statement(s) is /are correct?
    (a) H_2O_2 is prepared on an industrial scale by the autoxidation of 4-alkyl anthraquinols, which is extracted by water and concentrated to ~30% (by weight) by distillation under reduced pressure.
    (b) H_2O_2 in gas phase adopts a skew configuration with a dihedral angle of 111.5°, which is due to the repulsive interaction of the O-H bonds with the lone pair of electrons on each O atom.
    (c) H_2O_2 (l) → H_2O (l) + ½ O_2 (g) ; $\Delta G^o = -119.2$ kJ mol^{-1}
    In the absence of catalysts, H_2O_2 decomposes negligibly slow but the above reaction is strongly catalysed by metal surfaces (Pt, Ag) or by MnO_2 or by the traces of alkali (dissolved from glass).
    (d) H_2O_2 oxidises Mn^{2+} to Mn^{4+} in alkaline medium and reduces MnO_4^- to Mn^{2+} in acidic medium.

58. The following figure shows variation of the de Broglie wavelength λ with the kinetic energy (E), velocity (v), momentum (p) and the applied electric field for two particles namely an electron and a proton. Qualitatively the curves X and Y represent the two particles.



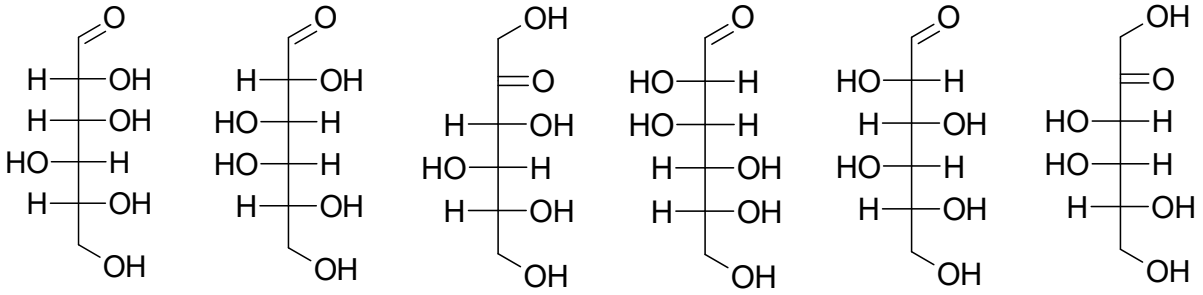
The statement(s) that are true according to the figure is /are
    (a) the curve X is for an electron and curve Y is for a proton, if the two carries equal energy
    (b) the curve X is for an electron and curve Y is for a proton, if the two are moving with equal velocity.
    (c) the curve X is for an electron and curve Y is for a proton, if the two are having equal momentum.
    (d) the curve X is for an electron and curve Y is for a proton, if the two have been accelerated by same electric field.

59. Osazones are derivatives of carbohydrates, obtained by the reaction of excess phenyl hydrazine with the carbohydrate. A general representation of the structure of osazone derivative is drawn below:



α-hydroxy alehyde osazone derivative

A few structures **I, II, III, IV, V** and **VI** of monosaccharides are drawn below.

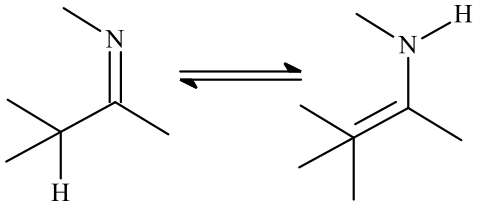


I **II** **III** **IV** **V** **VI**

From the above structures, mark the pair(s) in the options that will give the same osazone derivative.

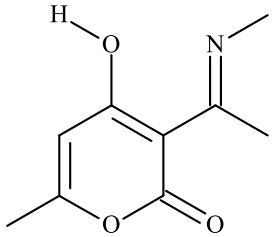
(a) I and III (b) II and VI (c) II and III (d) I and V

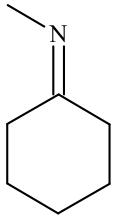
60. Similar to the keto-enol tautomerism is another common tautomeric relationship consisting of equilibrium between **imines** (also known as Schiff bases) and **enamines**, which are the nitrogen equivalents of enols. An illustration is shown below.

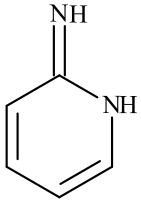


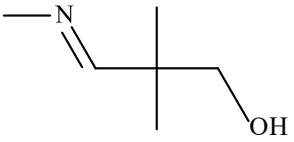
imine enamine

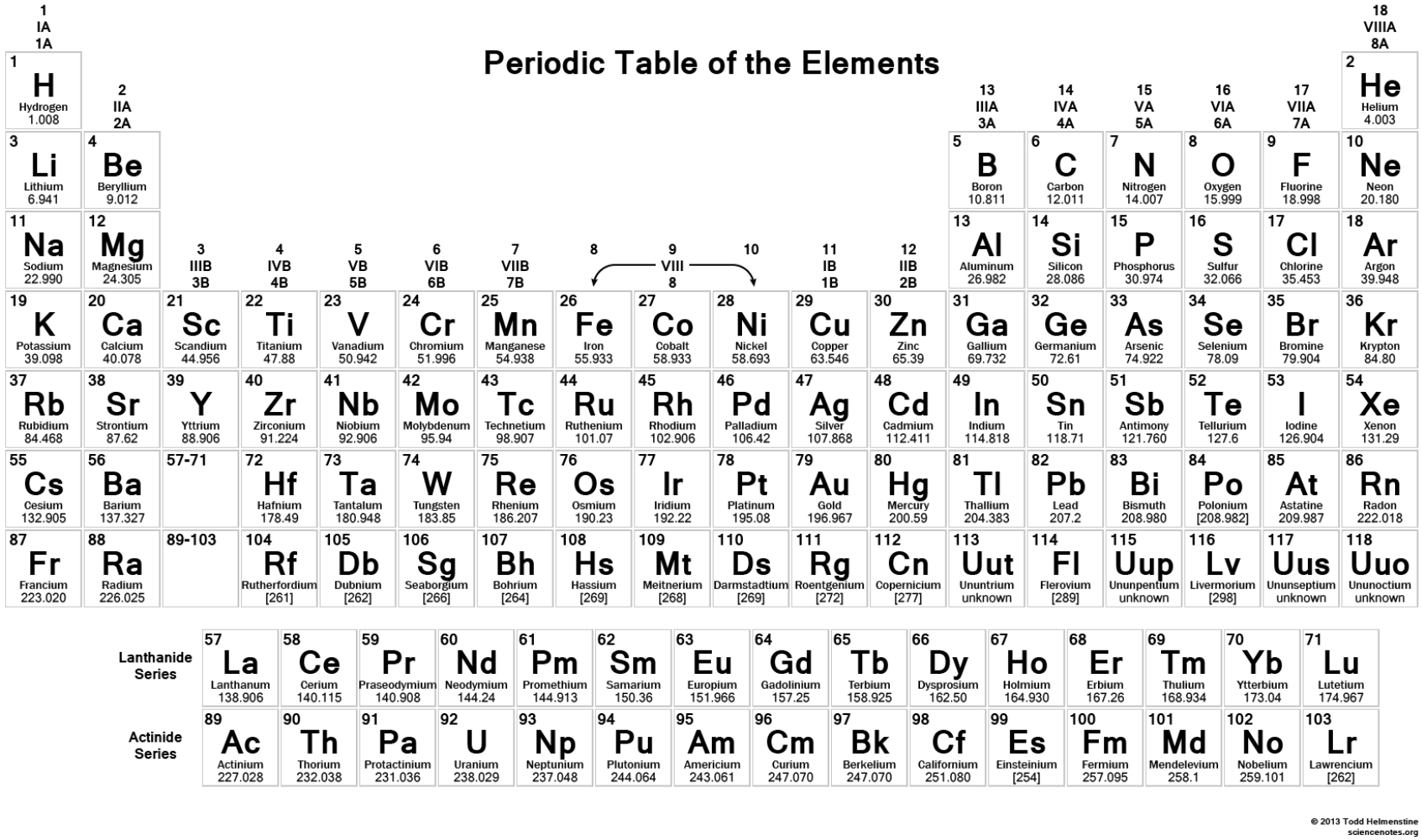
Which of the following can exhibit imine-enamine tautomerism?

(a) 

(b) 

(c) 

(d) 



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Rough Work