

YIJC 2025 H2 Chemistry Paper 1 Suggested Solutions

1	2	3	4	5
B	D	D	B	B
6	7	8	9	10
B	D	C	B	C
11	12	13	14	15
A	D	B	C	B
16	17	18	19	20
D	C	A	C	C
21	22	23	24	25
D	C	D	C	B
26	27	28	29	30
B	D	C	A	D

1 Answer: B

Negatively charged ions attracted to positive plate, positive ions to negative plate. D must be negatively-charged, while E and F are positively-charged.

Angle of deflection is proportional to charge/mass ratio. Since D and E have roughly the same angle of deflection but different polarity, D and E must have roughly the same charge/mass ratio.

F has almost double the angle of deflection as E, so the charge/mass ratio of F must be almost double that of E.

particles	$^{14}\text{N}^-$	$^{28}\text{Si}^{2+}$	$^{14}\text{C}^{2+}$
charge / mass	1/14	$2/28 = 1/14$	$2/14 = 1/7$

2 Answer: D

The sharp rise between 2nd and 3rd I.E. shows that there are 2 valence electrons in the outermost shell. Hence G is in Group 2. The outermost electronic configuration is ns^2 .

It cannot be in Period 3 because Mg (Group 2 in Period 3) has only 12 electrons, and so cannot have 13 successive IEs.

The next inner quantum shell contains 8 electrons, as seen by the 8 IEs before the next sharp rise. For a d-block element, the next inner quantum shell should contain 3s, 3p and 3d electrons, which would be more than 8.

It is not Al as Al has 3 valence electrons.

3 Answer: D

While alcohols have intermolecular hydrogen bonding between molecules, as the carbon chain length of an alcohol increases, the boiling point increases as the vdW interactions become stronger due to the larger and more polarisable electron cloud.

Hydrogen chloride dissociates and releases an H^+ that forms dative bond, not hydrogen bond, with water molecules to produce H_3O^+ .

CH_3CHO has a higher boiling point than $\text{CH}_3\text{CH}_2\text{CH}_3$ due to stronger permanent dipole-permanent dipole attraction between CH_3CHO molecules, and not intermolecular hydrogen bonding.

In ice, each water molecule forms 4 hydrogen bonding with 4 other water molecules. These hydrogen bonds are relatively long, giving rise to an open structure. In liquid, water molecules aggregate together via hydrogen bonding. Hence, ice has a lower density than water at 0°C .

4 Answer: B

Option 2 is non-polar molecule. AlCl_3 is trigonal planar in shape and there is no net dipole moment in the molecule as all the dipole moments cancel out each other.

Option 3 is non-polar molecule. CO_2 is linear in shape and there is no net dipole moment in the molecule as all the dipole moments cancel out each other.

Option 1 and 4 are polar as there is net dipole moment in the molecule.

5 Answer: B

Option A is correct as Al is a metal (solid) that conducts electricity.

Option B is wrong as Al_2O_3 is insoluble in water.

Option C is correct as Al^{3+} has high charge density so it can undergo hydrolysis in water to form an acidic solution.

Option D is correct as Al_2O_3 is amphoteric.

6 Answer: B

Option 1 is correct: The valence orbital gets larger / more diffuse as we go down Group 17, and the overlap of the orbital with $1s$ orbital of H gets less effective. Thus, the H-X bond strength decreases.

Option 2 is correct: The thermal stability of HX decreases down Group 17 due to the weaker H-X bond, which is easier to break.

Option 3 is incorrect: Decomposition of HX involves breaking covalent bond, not intermolecular forces of attraction which is influenced by electron cloud size.

7 **Answer: D**

Statement 1: Correct

Statement 2: Incorrect. Relative molecular mass is the average mass of one **molecule**, and not an atom in the molecule.

Statement 3: Incorrect. One mole of a compound contains as many **units** of that compound as there are atoms in 12.00 g of carbon-12. A compound is made up of at least 2 atoms / ions. Hence, there will not be the same number of **atoms** as there are atoms in 12.00 g of carbon-12.

8 **Answer: C**

At room temperature and pressure, all the water vapour has become liquid water. Thus, the 0.00208 mol of gas refers to $\text{N}_2\text{O}(\text{g})$.

Amount of $\text{N}_2\text{O}(\text{g})$ formed = 0.00208 mol

Amount of NH_4NO_3 decomposed = 0.00208 mol

Mass of NH_4NO_3 decomposed = $0.00208 \times (14+4+14+3 \times 16) = 0.167 \text{ g}$

Percentage decomposed = $0.167 / 0.2 \times 100\% = 83.3\%$

9 **Answer: B**

1.00 g of propan-1-ol = 0.016667 mol

Heat absorbed by water, $q = mc\Delta T = (200)(4.18)(39.5) = 33022 \text{ J}$

Since efficiency of heat transferred is 90%, heat released by combustion of propan-1-ol = $33022 \times (100/90) = 36691 \text{ J}$

$\Delta H_c = -36691 / 0.016667 = -2200$

10 Answer: C

The **least negative lattice energy** (i.e., weakest ionic bond) is for the compound with:

- Low ionic charge
- Large ionic radii
→ sodium azide

Ions	Charges	Radii	Expected Lattice Energy
Mg^{2+} and N_3^-	Higher	Small cation but larger anion	more negative
Mg^{2+} and N^{3-}	Higher	Small cation and anion	most negative
Na^+ and N_3^-	Lower	Large cation and larger anion	least negative
Na^+ and N^{3-}	Lower	Large cation but smaller anion	less negative

11 Answer: A

Statements 1 and 2 are correct.

- 1 Between 0 K and 195 K, entropy is low as the NH_3 molecules are held in their fixed positions in the solid state.
Statement 1 is correct.
- 2 Between 195 K and 240 K, there is an increase in the number of ways to distribute energy among NH_3 molecules.
Statement 2 is correct.
- 3 At 240 K, there is an increase in the number of NH_3 molecules and hence number of ways to arrange NH_3 molecules.
Statement 3 is incorrect, as there is no addition of NH_3 molecules to the system, although the number of gaseous NH_3 has increased.

12 Answer: D

$$\text{rate} = k[\text{sucrose}][\text{acid}]$$

When [acid] is doubled, rate is doubled.

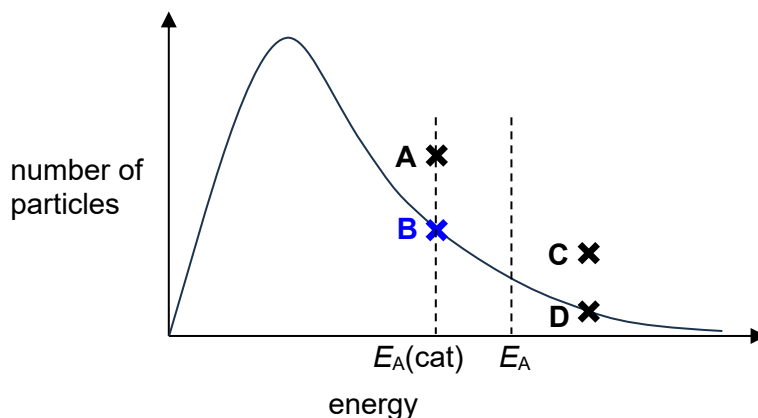
However, since acid is a catalyst, [acid] is constant. So, $\text{rate} = k'[\text{sucrose}]$, where $k' = k[\text{acid}]$. This is a pseudo first-order reaction.

$$\text{Half-life, } t_{1/2} = (\ln 2) / k' = (\ln 2) / (k[\text{acid}])$$

When [acid] is doubled, $(\ln 2) / (k[\text{acid}])$ is halved since [acid] appears in the denominator.

13 Answer: B

The distribution curve does not change since temperature is kept constant. However, with a catalyst, E_A is lowered.



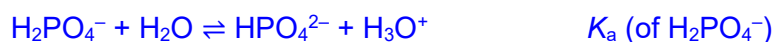
14 Answer: C

equilibrium 1	$\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{H}^+$	K_1
equilibrium 2	$\text{HCO}_3^- \rightleftharpoons \text{CO}_3^{2-} + \text{H}^+$	K_2
equilibrium 2 (reversed)	$\text{CO}_3^{2-} + \text{H}^+ \rightleftharpoons \text{HCO}_3^-$	$1 / K_2$
equilibrium 3 (add eqm 1 and eqm 2(reversed))	$\text{CO}_2 + \text{H}_2\text{O} + \text{CO}_3^{2-} \rightleftharpoons 2\text{HCO}_3^-$	$K_3 = K_1 \times (1 / K_2)$

15 Answer: B

When temperature increases, the system will want to decrease the temperature by favouring the endothermic reaction to absorb heat. Since backward reaction is endothermic, reaction will shift to the left. This will result in more reactants than products, hence K_p will decrease.

16 Answer: D

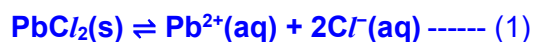


$$K_w = K_a \text{ (acid)} \times K_b \text{ (conjugate base)}$$

$$\text{i.e., } 1.00 \times 10^{-14} = K_a \text{ (of } \text{H}_2\text{PO}_4^-) \times K_b \text{ (of } \text{HPO}_4^{2-})$$

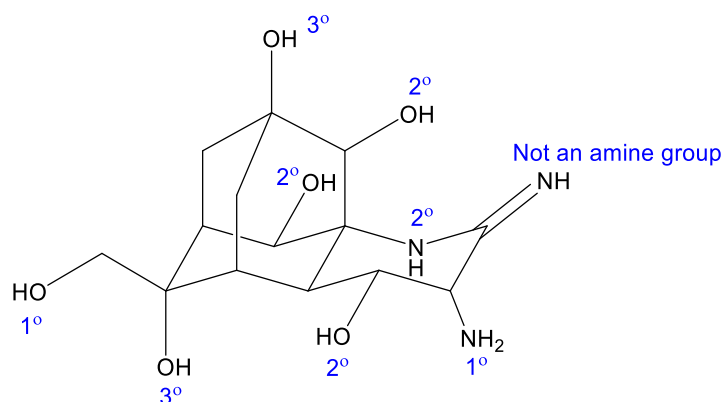
$$\frac{1.00 \times 10^{-14}}{6.3 \times 10^{-8}} = \frac{K_w}{K_a(\text{H}_2\text{PO}_4^-)} = K_b \text{ (conjugate base of } \text{H}_2\text{PO}_4^-) = K_b (\text{HPO}_4^{2-})$$

17 Answer: C



A	True. K_{sp} is only dependent on temperature.
B	True. As more Cl^{-} is added, the position of equilibrium (1) will shift to the left, causing the solubility of PbCl_2 to decrease. This is known as the common ion effect.
C	False. At M, the concentration of Cl^{-} is not necessarily twice that of Pb^{2+} as Cl^{-} is also contributed by the addition of KCl .
D	True. $\text{Pb}^{2+}(\text{aq}) + 4\text{Cl}^{-}(\text{aq}) \rightleftharpoons [\text{PbCl}_4]^{2-}(\text{aq})$ When even more Cl^{-} is added, a soluble complex $[\text{PbCl}_4]^{2-}$ is formed. The formation of this complex decreases the $[\text{Pb}^{2+}]$, causing the position of equilibrium (1) to shift to the right. This increases the solubility of PbCl_2 .

18 Answer: A

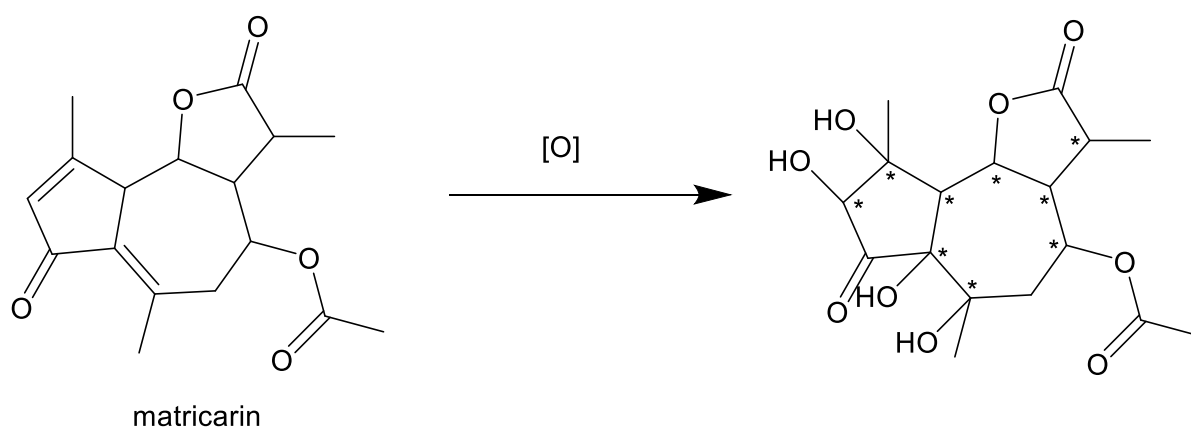


Option 1 is correct. (Refer to diagram)

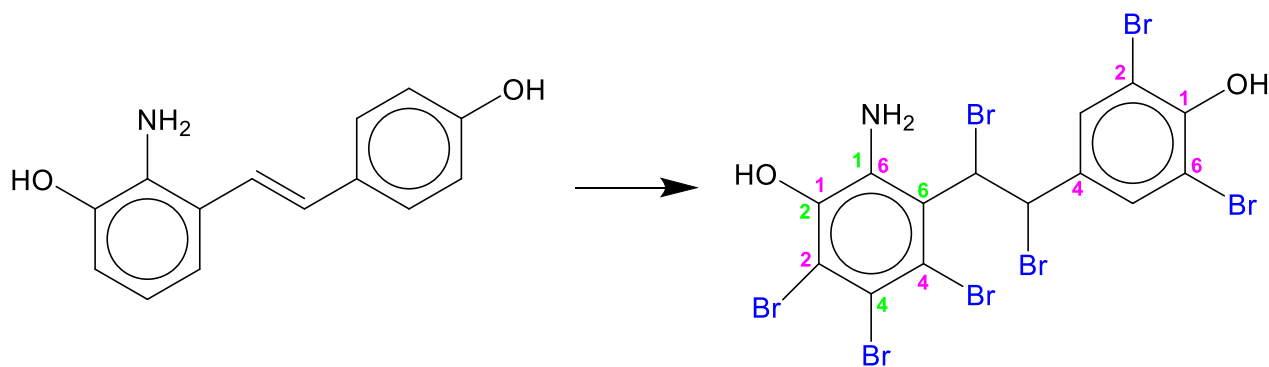
Option 2 is correct. (Refer to diagram)

Option 3 is incorrect as there's only 1 primary amine group.

19 Answer: C



20 Answer: C



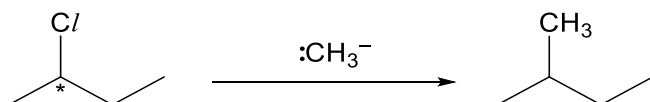
Phenols get substituted at 2,4,6- positions with $\text{Br}_2(\text{aq})$.

Phenylamines get substituted at 2,4,6- positions with $\text{Br}_2(\text{aq})$.

Note that these positions are relative positions to where the OH and NH_2 are.

Although major product of electrophilic addition to alkene is 1 Br and 1 OH, the question is asking about the *maximum number* of bromine atoms that can be incorporated. In the case of alkene, it is 2 Br.

21 Answer: D



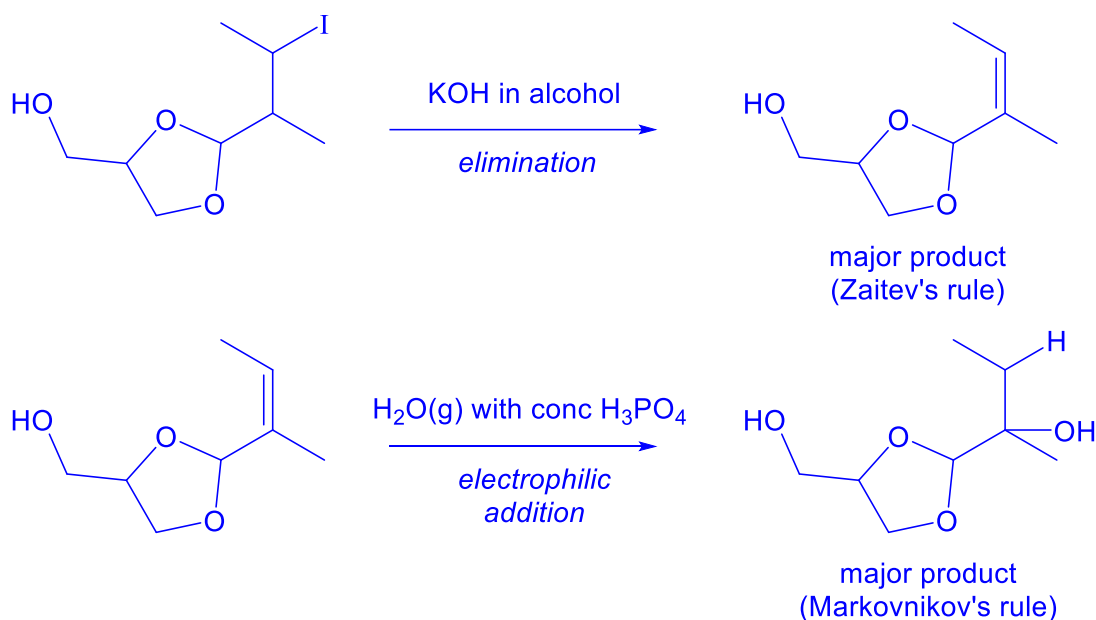
After the reaction, the product is not a chiral molecule. So it does not rotate-plane polarised light.

As a result, we are unable to conclude whether this is due to racemisation (i.e., whether it was $\text{S}_{\text{N}}1$).

We are also not able to rule out $\text{S}_{\text{N}}2$.

However, whether $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$, the slow step will involve 2-chlorobutane. So [2-chlorobutane] appears in the rate equation and the rate of reaction is dependent on [2-chlorobutane].

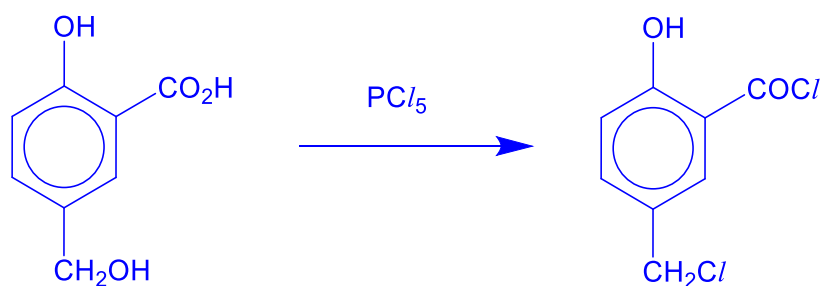
22 Answer: C



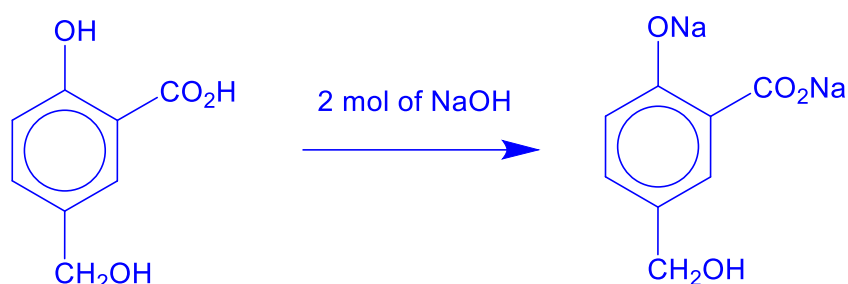
23 Answer: D

		$\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$	$\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$	$\text{HCOCH}_2\text{CO}_2\text{H}$
A	warm alkaline aqueous iodine		✓	
	PCl_5	✓		✓
	Cannot differentiate between $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ and $\text{HCOCH}_2\text{CO}_2\text{H}$			
B	Fehling's solution			✓
	NaHCO_3	✓	✓	
	Cannot differentiate between $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ and $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$			
C	PCl_5	✓	✓	✓
	warm acidified potassium dichromate(VI)		✓	✓
Cannot differentiate between $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$ and $\text{HCOCH}_2\text{CO}_2\text{H}$				
D	warm acidified potassium dichromate(VI)		✓	✓
	Fehling's solution			✓
	$\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ can be identified from Test 1 when it is the only one that gives a negative observation. $\text{HCOCH}_2\text{CO}_2\text{H}$ will give a positive observation in Test 2 while $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$ will give a negative observation.			

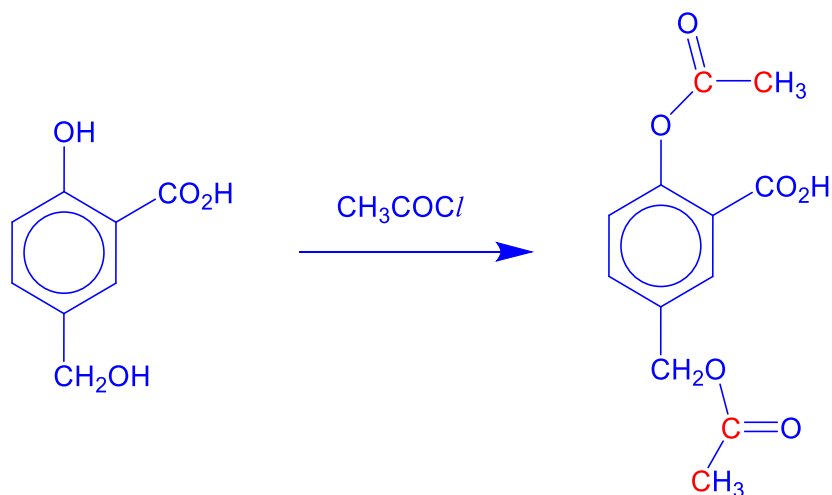
24 Answer: C



Only two chlorine atoms can be seen in product.



Since both RCOOH and phenol group will react, 2 moles of NaOH will be needed.



Both alcohol and phenol can undergo condensation with ethanoyl chloride, hence 4 carbons will be incorporated.

25 Answer: B

Option 1 is correct. Alkene's electron rich $\text{C}=\text{C}$ will repel H^- .

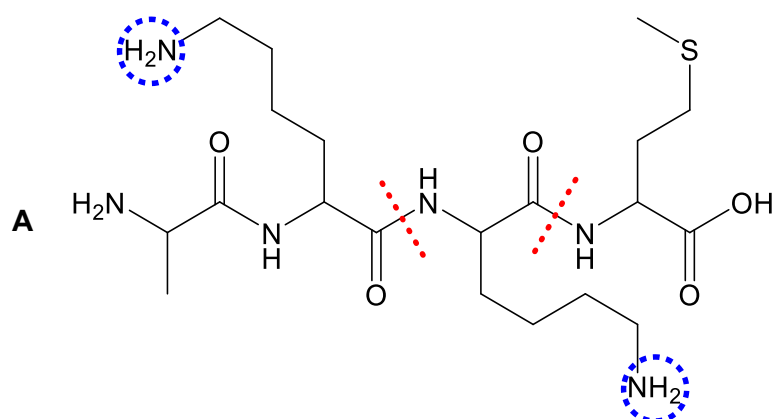
Option 2 is correct. The electron-deficient C of $\text{C}=\text{O}$ attracts the H^- to attack the carbon for reaction.

Option 3 is incorrect. While alkenes could have greater steric hindrance (both C can have 2 groups bonded while $\text{C}=\text{O}$ only has maximum 2 groups since there is only 1 C), LiAlH_4 works by releasing H^- (very small ion). Thus, steric hindrance cannot explain the observation.

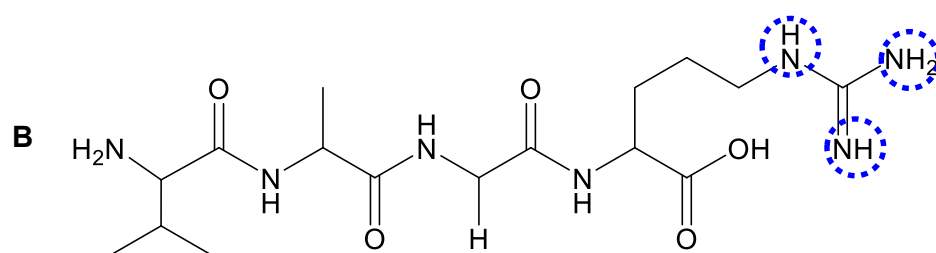
26 Answer: B

- A** It can react with $\text{H}_2\text{SO}_4(\text{aq})$ in an acid-base reaction
Incorrect, it will be a hydrolysis reaction.
- B** When heated with $\text{NaOH}(\text{aq})$, it will form sodium propanoate
Correct, upon alkaline hydrolysis, RCO_2^- will react with Na^+ to give $\text{RCO}_2^- \text{Na}^+$.
- C** When heated with $\text{H}_2\text{SO}_4(\text{aq})$, it will form ethanoic acid
Incorrect, upon acidic hydrolysis, it will form $\text{C}_2\text{H}_5\text{CO}_2\text{H}$, propanoic acid + NH_3
- D** It can be formed using propanoic acid and $\text{NH}_3(\text{aq})$ at room temperature
Incorrect, $\text{RCO}_2\text{H} + \text{RNH}_2 \rightarrow \text{RNH}_3^+ \text{RCO}_2^-$. It can be formed with propanoyl chloride and aqueous ammonia.

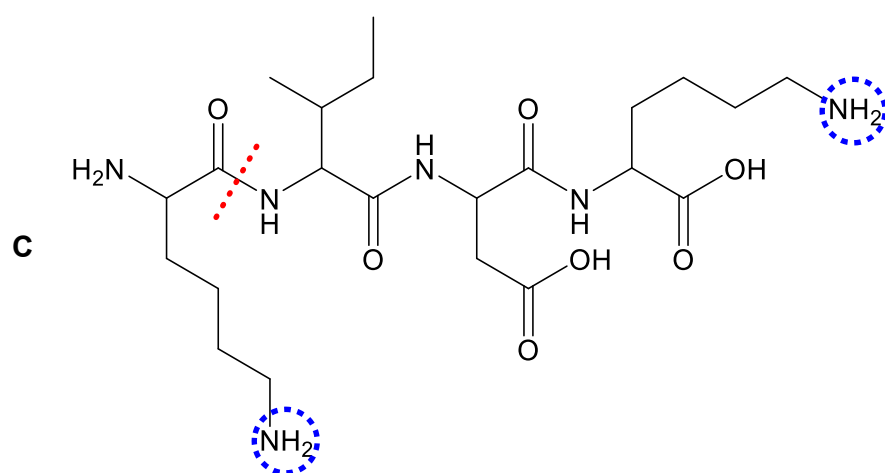
27 Answer: D



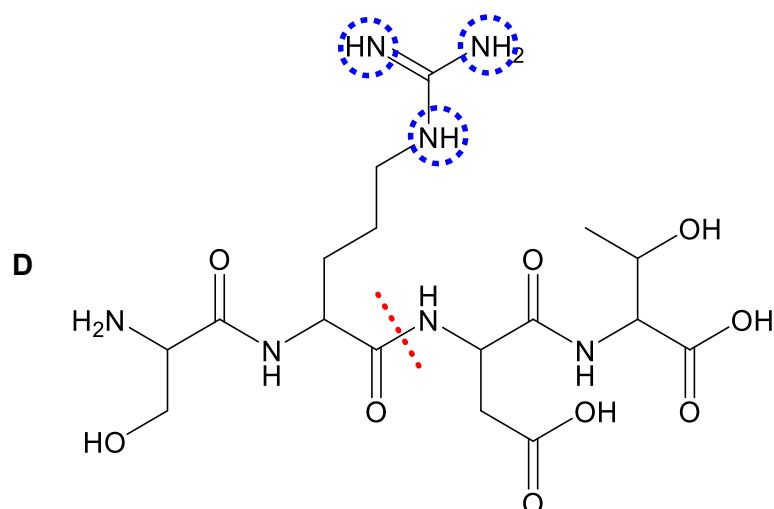
Dipeptide + 2
amino acids
formed



No hydrolysis



1 amino acid +
tripeptide
formed



2 different
dipeptides
formed

28 Answer: C

A: Ca^{2+} and MnO_4^- cannot react because both are oxidising agents.

B: Cl^- and Cu cannot react because both are reducing agents.

C: $E^\ominus_{\text{cell}} = +1.07 - (+0.77) = +0.30 \text{ V}$ (spontaneous)

D: $E^\ominus_{\text{cell}} = -1.66 - (+1.36) = -3.02 \text{ V}$ (not spontaneous)

29 Answer: A

V is the cathode and W is the anode.

Fe^{2+} and water are attracted to the cathode V but Fe^{2+} is preferentially reduced at V because $E^\ominus(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$ is less negative (more positive) than $E^\ominus(\text{H}_2\text{O}/\text{H}_2) = -0.83 \text{ V}$.

Cl^- and water are attracted to the anode W. Comparing E^\ominus values, water should be preferentially oxidised at W since $E^\ominus(\text{O}_2/\text{H}_2\text{O}) = +1.23 \text{ V}$ is less positive than $E^\ominus(\text{Cl}_2/\text{Cl}^-) = +1.36 \text{ V}$.

However, since it is concentrated solution of FeCl_2 , the $E^\ominus(\text{Cl}_2/\text{Cl}^-)$ becomes less positive than $+1.23 \text{ V}$. So Cl^- is preferentially oxidised to Cl_2 at W.

30 Answer: D

Mass of chromium compound ($\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$) = 0.95 g

No of moles of chromium compound ($\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$) = $0.95 \div 266.5 = 3.564 \times 10^{-3} \text{ mol}$

Mass of AgCl = 0.50 g

No of moles of AgCl = $0.50 \div 143.4 = 3.486 \times 10^{-3} \text{ mol}$

No of moles of free Cl^- ion = $3.486 \times 10^{-3} \text{ mol}$

Since mole ratio of Cl^- ion : $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ = 1 : 1, it means that 1 Cl^- ion is free for every unit of the compound.

Thus, the formula of the chromium ion is $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]^+$.