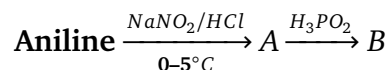




1. Aniline is converted into benzene by the following sequence of reactions:



The compounds A and B respectively are:

- (A) Benzene diazonium chloride, Benzene
- (B) Nitrobenzene, Benzene
- (C) Benzene diazonium chloride, Phenol
- (D) Chlorobenzene, Benzene

Correct Answer: (1) Benzene diazonium chloride, Benzene

Solution:

Concept:

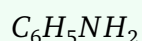
This question is based on:

- Diazotisation reaction
- Reduction of diazonium salts
- Important NCERT named reactions

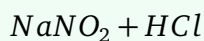
Primary aromatic amines react with nitrous acid at low temperature to form diazonium salts. Further reduction using hypophosphorous acid replaces diazonium group by hydrogen.

Step 1: Formation of diazonium salt.

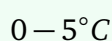
Aniline:



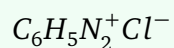
reacts with:



at:



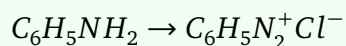
to form benzene diazonium chloride:



Thus:

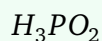
A = Benzene diazonium chloride

Reaction:



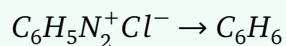
Step 2: Reduction of diazonium salt.

Hypophosphorous acid:



reduces diazonium group into hydrogen.

Thus:



Hence:

B = Benzene

Step 3: Identify the correct option.

Therefore:

A = Benzene diazonium chloride

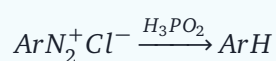
and

B = Benzene

Hence correct option is:

(A)

Quick Tip: Remember:



Hypophosphorous acid replaces diazonium group by hydrogen.

2. Among the following compounds, the correct order of acidic strength is:

Phenol, *p*-Nitrophenol, *p*-Methoxyphenol

- (A) *p*-Methoxyphenol > Phenol > *p*-Nitrophenol
(B) *p*-Nitrophenol > Phenol > *p*-Methoxyphenol
(C) Phenol > *p*-Nitrophenol > *p*-Methoxyphenol
(D) *p*-Nitrophenol > *p*-Methoxyphenol > Phenol

Correct Answer: (2) *p*-Nitrophenol > Phenol > *p*-Methoxyphenol

Solution:

Concept:

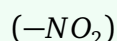
Acidic strength depends upon stability of conjugate base.

- Electron withdrawing groups increase acidity
- Electron donating groups decrease acidity

Greater stabilization of phenoxide ion means stronger acid.

Step 1: Analyse *p*-nitrophenol.

Nitro group:



is strongly electron withdrawing.

It stabilizes phenoxide ion by:

- $-I$ effect
- $-R$ effect

Thus acidity increases significantly.

Therefore:

p-Nitrophenol is most acidic

Step 2: Analyse phenol.

Phenol has no strong substituent.

Hence its acidity is intermediate.

Step 3: Analyse *p*-methoxyphenol.

Methoxy group:



is electron donating through resonance.

It destabilizes phenoxide ion.

Thus acidity decreases.

Therefore:

p-Methoxyphenol is least acidic

Step 4: Write the correct order.

Hence:

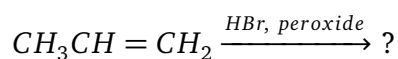
p-Nitrophenol > Phenol > *p*-Methoxyphenol

Thus the correct option is:

(B)

Quick Tip: Electron withdrawing groups increase acidity by stabilizing conjugate base, while electron donating groups decrease acidity by destabilizing the conjugate base.

3. The major product formed in the following reaction is:



- (A) $CH_3CHBrCH_3$
- (B) $CH_3CH_2CH_2Br$
- (C) $CH_2BrCH=CH_2$
- (D) $CH_3CHBrCH_2Br$

Correct Answer: (2) $CH_3CH_2CH_2Br$

Solution:

Concept:

Addition of HBr in presence of peroxide follows:

Anti-Markovnikov rule

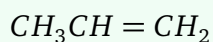
This reaction is known as:

Peroxide effect or Kharasch effect

Free radical mechanism causes bromine to attach to less substituted carbon atom.

Step 1: Identify the alkene.

Given alkene:



This is propene.

Step 2: Understand peroxide effect.

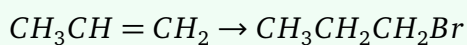
In presence of peroxide:



adds through free radical mechanism.

Bromine attaches to terminal carbon.

Thus:

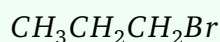


Step 3: Identify the product.

The product formed is:

1-Bromopropane

Structure:



Hence correct option is:

(B)

Quick Tip: Peroxide effect is shown only by HBr and not by HCl or HI.



4. The SI unit of rate constant for a first order reaction is:

- (A) $\text{mol L}^{-1}\text{s}^{-1}$
- (B) s^{-1}
- (C) $\text{L mol}^{-1}\text{s}^{-1}$
- (D) $\text{mol}^{-1}\text{L s}^{-1}$

Correct Answer: (2) s^{-1}

Solution:

Concept:

For a first order reaction:

$$\text{Rate} = k[A]$$

The unit of rate constant depends on reaction order.

Step 1: Write units of rate and concentration.

Units of rate:

$$\text{mol L}^{-1}\text{s}^{-1}$$

Units of concentration:

$$\text{mol L}^{-1}$$

Step 2: Substitute into rate law.

For first order:

$$k = \frac{\text{Rate}}{[A]}$$

Thus:

$$k = \frac{\text{mol L}^{-1}\text{s}^{-1}}{\text{mol L}^{-1}}$$

Cancelling concentration units:

$$k = \text{s}^{-1}$$

Step 3: Write final answer.

Hence SI unit of first order rate constant is:

$$s^{-1}$$

Therefore correct option is:

$$(B)$$

Quick Tip: For a first order reaction:

$$k = s^{-1}$$

The unit depends only on reaction order, not on reaction mechanism.

5. Which of the following complexes shows maximum number of unpaired electrons?

- (A) $[Fe(CN)_6]^{4-}$
- (B) $[FeF_6]^{3-}$
- (C) $[Co(NH_3)_6]^{3+}$
- (D) $[Ni(CO)_4]$

Correct Answer: (2) $[FeF_6]^{3-}$

Solution:

Concept:

Number of unpaired electrons depends on:

- Oxidation state of metal
- Nature of ligand
- Crystal field splitting
- Weak field or strong field ligands

Weak field ligands produce high spin complexes with more unpaired electrons.

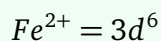
Step 1: Analyse $[Fe(CN)_6]^{4-}$.

Oxidation state of Fe:

$$x + 6(-1) = -4$$

$$x = +2$$

Electronic configuration:



CN^- is strong field ligand.

Thus low spin complex forms.

Number of unpaired electrons:

$$0$$

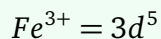
Step 2: Analyse $[FeF_6]^{3-}$.

Oxidation state:

$$x + 6(-1) = -3$$

$$x = +3$$

Thus:



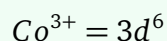
F^- is weak field ligand.

Hence high spin complex forms.

Electronic arrangement gives:

5 unpaired electrons

Step 3: Analyse $[Co(NH_3)_6]^{3+}$.



NH_3 acts as strong field ligand for Co^{3+} .

Low spin complex forms.

Number of unpaired electrons:

$$0$$

Step 4: Analyse $[Ni(CO)_4]$.

Nickel oxidation state:

0

CO is strong field ligand.

All electrons become paired.

Thus:

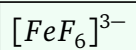
0 unpaired electrons

Step 5: Identify the complex with maximum unpaired electrons.

Maximum unpaired electrons:

5

present in:



Therefore, the correct option is:

(B)

Quick Tip: Weak field ligands such as:



usually form high spin complexes with maximum unpaired electrons.

6. The correct increasing order of basic strength of the following amines/compounds is:

(I) $C_6H_5NH_2$ (Aniline)

(II) NH_3 (Ammonia)

(III) $C_6H_5CH_2NH_2$ (Benzylamine)

(IV) $C_2H_5NH_2$ (Ethylamine)

(V) $(C_2H_5)_2NH$ (Diethylamine)

(A) $C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$

(B) $NH_3 < C_6H_5NH_2 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$

(C) $C_6H_5CH_2NH_2 < C_6H_5NH_2 < NH_3 < C_2H_5NH_2 < (C_2H_5)_2NH$

(D) $C_2H_5NH_2 < (C_2H_5)_2NH < C_6H_5NH_2 < NH_3$

Correct Answer: (A) $C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$

Solution:

Concept:

The basic strength of amines depends upon the availability of the lone pair of electrons on the nitrogen atom for donation to a proton (H^+). Greater the availability of the lone pair, greater will be the basic strength.

The important factors affecting basicity are:

- **Inductive Effect (+I effect):** Alkyl groups donate electron density toward nitrogen, increasing basicity.
- **Resonance Effect:** Delocalization of lone pair decreases its availability and decreases basicity.
- **Solvation Effect:** Stabilization of protonated species in aqueous medium affects basicity.
- **Steric Hindrance:** Bulky groups can reduce protonation efficiency.

Step 1: Analyzing Aniline ($C_6H_5NH_2$).

In aniline, the lone pair on nitrogen is directly involved in resonance with the benzene ring.



Due to resonance:

- Lone pair becomes delocalized.
- Electron density on nitrogen decreases.
- Availability of lone pair for protonation decreases.

Hence, Aniline is the weakest base among all the given compounds.



Step 2: Analyzing Ammonia (NH_3).

Ammonia contains a localized lone pair on nitrogen.

There is:

- No resonance effect.
- No electron donating alkyl group.

Thus, Ammonia is more basic than Aniline but weaker than aliphatic amines.

Step 3: Analyzing Benzylamine ($C_6H_5CH_2NH_2$).

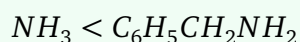
In Benzylamine:

- The $-NH_2$ group is attached to sp^3 hybridized carbon.
- Lone pair cannot participate in resonance with benzene ring.

Therefore:

- Lone pair remains available.
- Basicity increases compared to ammonia.

Thus:



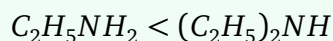
Step 4: Analyzing Ethylamine and Diethylamine.

Ethyl groups show strong $+I$ effect.

- Ethylamine has one ethyl group.
- Diethylamine has two ethyl groups.

More alkyl groups increase electron density on nitrogen.

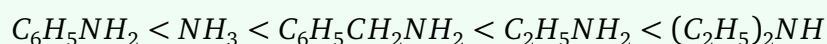
Thus:



Also both are stronger bases than ammonia and benzylamine.

Step 5: Combining all observations.

Final increasing order of basic strength becomes:



Hence, the correct option is:

(A)

Quick Tip: Aromatic amines are weaker bases because resonance delocalizes the lone pair on nitrogen. Aliphatic amines are stronger due to the +I effect of alkyl groups.

7. When blood cells are placed in 1% (w/v) NaCl aqueous solution, what will happen to the cells?

- (A) Cell will burst
- (B) Cell will shrink
- (C) Cell will swell
- (D) Cell remains as such

Correct Answer: (B) Cell will shrink

Solution:

Concept:

This question is based on:

- Osmosis
- Hypertonic and hypotonic solutions
- Osmotic pressure

Osmosis is the movement of solvent molecules through a semipermeable membrane from lower solute concentration to higher solute concentration.

For human blood cells:

0.9% NaCl solution

is approximately isotonic.

Step 1: Identify the nature of the external solution.

Given external solution:

1% NaCl

Normal isotonic concentration:

0.9% NaCl

Since:

$1\% > 0.9\%$

the external solution is hypertonic.

Step 2: Determine direction of osmosis.

In a hypertonic solution:

- Solute concentration outside cell is greater.
- Water moves out of the cell.

This outward movement of water is called:

Exosmosis

Step 3: Determine the effect on blood cell.

As water leaves the blood cell:

- Cell volume decreases.
- Cell membrane contracts inward.

Therefore, the blood cell shrinks.

This shrinking is known as:

Crenation

Step 4: Write the final answer.

Hence:

Cell will shrink

Therefore, the correct option is:

(B)

Quick Tip: Remember:

- Hypertonic solution → Cell shrinks
- Hypotonic solution → Cell swells/bursts
- Isotonic solution → No change

8. Which of the following solutions is isotonic with human blood?

- (A) 0.1% NaCl solution
- (B) 0.5% NaCl solution
- (C) 0.9% NaCl solution
- (D) 2% NaCl solution

Correct Answer: (C) 0.9% NaCl solution

Solution:

Concept:

An isotonic solution is a solution having the same osmotic pressure as the fluid inside human blood cells.

In isotonic conditions:

- No net movement of water occurs.
- Blood cells neither shrink nor swell.

Human blood plasma is isotonic with approximately:

0.9% NaCl solution

Step 1: Understand isotonicity.

If external solution concentration equals internal cell concentration:

Water entering = Water leaving

Thus:

- Cell size remains unchanged.
- Osmotic equilibrium is maintained.

Step 2: Compare all options.

- 0.1% NaCl: Hypotonic
- 0.5% NaCl: Hypotonic
- 0.9% NaCl: Isotonic
- 2% NaCl: Hypertonic

Thus only:

0.9% NaCl

matches blood osmotic pressure.

Step 3: Write the final answer.

Hence, isotonic solution is:

0.9% NaCl solution

Therefore, the correct option is:

(C)

Quick Tip: Physiological saline or normal saline used in hospitals is:

0.9% NaCl

because it is isotonic with human blood.

9. Which of the following compounds will not undergo an Azo coupling reaction?

- (A) Aniline
- (B) Phenol
- (C) Anisole
- (D) Nitrobenzene

Correct Answer: (D) Nitrobenzene

Solution:

Concept:

Azo coupling reaction is an important electrophilic aromatic substitution reaction involving diazonium salts.

In this reaction:



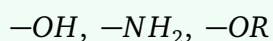
acts as a weak electrophile.

Therefore, azo coupling occurs only with highly activated aromatic rings containing strong electron donating groups.

Important points:

- Electron donating groups activate the ring.
- Electron withdrawing groups deactivate the ring.
- Activated rings undergo azo coupling easily.

Examples of activating groups:



Examples of deactivating groups:



Step 1: Analyzing Aniline ($C_6H_5NH_2$).

Aniline contains:



group.

The lone pair on nitrogen participates in resonance and increases electron density in the benzene ring.

Thus:

- Ring becomes highly activated.
- Electrophilic substitution becomes easier.

Hence, Aniline undergoes azo coupling reaction.

Step 2: Analyzing Phenol (C_6H_5OH).

Phenol contains:



group.

Oxygen donates electron density through resonance effect.

Therefore:

- Ring becomes activated.
- Phenol reacts readily with diazonium salts.

Hence, Phenol undergoes azo coupling reaction.

Step 3: Analyzing Anisole ($C_6H_5OCH_3$).

Anisole contains:



group.

Methoxy group donates electrons through resonance.

Thus:

- Aromatic ring becomes electron rich.
- Electrophilic substitution occurs easily.

Hence, Anisole also undergoes azo coupling reaction.

Step 4: Analyzing Nitrobenzene ($C_6H_5NO_2$).

Nitro group:



is a strong electron withdrawing group.

It withdraws electron density by:

- $-I$ effect
- $-M$ effect

As a result:

- Benzene ring becomes strongly deactivated.
- Weak diazonium electrophile cannot attack the ring.

Therefore, Nitrobenzene does not undergo azo coupling reaction.

Step 5: Write the final answer.

Hence:

Nitrobenzene

Therefore, the correct option is:

(D)

Quick Tip: Azo coupling occurs easily with activated aromatic compounds such as phenols and aromatic amines. Strong electron withdrawing groups like $-\text{NO}_2$ prevent azo coupling.

10. Which of the following are fat soluble vitamins?

- (A) Vitamin A
- (B) Vitamin B
- (C) Vitamin D
- (D) Vitamin E
- (E) Vitamin K

Choose the correct answer from the options given below:

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

Correct Answer: (C) (A), (C), (D) and (E) only

Solution:

Concept:

Vitamins are essential organic compounds required in small quantities for proper growth, metabolism and maintenance of body functions.

Based on solubility, vitamins are classified into:

- Fat-soluble vitamins
- Water-soluble vitamins

Fat-soluble vitamins:

A, D, E, K

Water-soluble vitamins:

B-complex and Vitamin C

Fat-soluble vitamins:

- Dissolve in fats and oils
- Are stored in liver and adipose tissues
- Can accumulate in body

Step 1: Identify Vitamin A.

Vitamin A:

Retinol

is fat soluble.

It is important for:

- Vision

- Healthy epithelial tissues

Thus:

(A) is correct

Step 2: Identify Vitamin B.

Vitamin B belongs to:

Vitamin B-complex

These vitamins are water soluble.

Therefore:

(B) is not fat soluble

Step 3: Identify Vitamins D, E and K.

- Vitamin D helps calcium absorption.
- Vitamin E acts as antioxidant.
- Vitamin K is essential for blood clotting.

All three are fat soluble vitamins.

Thus:

(C), (D), (E)

are correct.

Step 4: Select the correct combination.

Fat-soluble vitamins are:

A, D, E, K

Hence correct combination is:

(A), (C), (D), (E)

Therefore, the correct option is:

(C)

Quick Tip: Remember the mnemonic:

ADEK

These are the four fat-soluble vitamins. Vitamins B and C are water soluble.
