ABC CHEMISTRY

Mr. Aniket Bhardwaj · 15+ Years Mentorship

Reagents, Named Reactions & Pericyclic

Premium CSIR-NET PYQ Book

24 Previous-Year Questions · 22 with verified answers · Distractor Analysis

3-Slide Solutions | Distractor Analysis | Exam Tricks | Revision Sheets

CSIR-NET · GATE · IIT-JAM — 2 Topics · 24 Real PYQs

(Mr. Aniket Bhardwaj By ABC Chemistry) · www.abcchemistry.com · 9212142427

Mr. Aniket Bhardwaj

@abcchemistry24

Instagram · YouTube · Facebook

Course Contents

2 Topics · 24 PYQs

1	**Reagents, Reaction Mechanisms & Named Reactions** 18 Qs E 4 · M 12 · H 2	75%	
2	**Reagents, Named Reactions & Pericyclic – General** 6 Qs E 1 · M 4 · H 1	25%	

Legend: **E** Easy **M** Medium **H** Hard · **%** = exam weightage (share of the chapter)

TOPIC 1

Reagents, Reaction Mechanisms & Named Reactions

18 questions · Easy 4 | Medium 12 | Hard 2 · PYQ frequency: Occasional

Q1 **Both 1-chloro-1-phenylpropan-2-one and 1-chloro-3-phenylpropan-2-one give same product A when heated in presence of NaOMe. The product A is**

(A) Methyl 3-phenylpropanoate

(B) Methyl 2- phenylpropanoate

(C) Methyl 2-methoxy-2-phenylacetate

(D) 1-methoxy-3-phenylpropan-2-one

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer A Methyl 3-phenylpropanoate

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Favorskii: both Î±-chloroketones give the same cyclopropanone; methoxide opens it to form the more stable benzylic carbanion, giving methyl 3-phenylpropanoate (a).
- Therefore the answer is (A).

FINAL: (A) Methyl 3-phenylpropanoate

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: A

B **Methyl 2- phenylpropanoate**

Why (A) is the key — Favorskii: both Î±-chloroketones give the same cyclopropanone; methoxide opens it to form the more stable benzylic carbanion, giving methyl 3-phenylpropanoate (a).

C **Methyl 2-methoxy-2-phenylacetate**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **1-methoxy-3-phenylpropan-2-one**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q2

(E)-3-bromo-3-hexene when treated with CH_3O^- in CH_3OH gives

A. 3-hexyne

B. 2-hexyne

C. 2, 3-hexadiene

D. 2, 4-hexadiene

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer C 2, 3-hexadiene

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- In (E)-3-bromo-3-hexene the vinylic H on C-4 is cis to Br, so anti E2 to the alkyne is impossible; methoxide instead removes the allylic C-2 H, giving the allene 2,3-hexadiene (c).
- Therefore the answer is (C).

FINAL: (C) 2, 3-hexadiene

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: C

A **3-hexyne**

Why (C) is the key — In (E)-3-bromo-3-hexene the vinylic H on C-4 is cis to Br, so anti E2 to the alkyne is impossible; methoxide instead removes the allylic C-2 H, giving the allene 2,3-hexadiene (c).

B **2-hexyne**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **2, 4-hexadiene**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q3 **Arrange the following halides in the decreasing order of S_N1 reactivity $CH_3CH_2CH_2Cl$, mathrmCH_2=CHCH(Cl)CH_3, $CH_3CH_2CH(Cl)CH_3$**

A) I > II > III

B) II > I > III

C) II > III > I

D) III > II > I

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer C II > III > I

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- S_N1 rate follows carbocation stability: allylic (II, resonance-stabilised) > secondary (III) > primary (I).
- Therefore the answer is (C).

FINAL: (C) II > III > I

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: C

A **I > II > III**

Why (C) is the key — S_N1 rate follows carbocation stability: allylic (II, resonance-stabilised) > secondary (III) > primary (I).

B **II > I > III**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **III > II > I**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q4

Classify the following species as electrophiles (E) and nucleophiles (N) in routine organic synthesis SO_3 Cl^+ CH_3NH_2 H_3O^+ BH_3 CN^-

A E = SO_3, Cl^+, BH_3; N = CH_3NH_2, H_3O^+, CN^-

B E = Cl^+, H_3O^+; N = SO_3, CH_3NH_2, BH_3, CN^-

C E = Cl^+, H_3O^+, BH_3; N = SO_3, CH_3NH_2, H_3O^+, CN^-

D E = SO_3, Cl^+, H_3O^+, BH_3; N = CH_3NH_2, CN^-

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer D $E = SO_3, Cl^+, H_3O^+, BH_3; N = CH_3NH_2, CN^-$

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Electrophiles (electron-deficient): SO_3, Cl^+, H_3O^+ (proton source), BH_3 (empty p orbital). Nucleophiles (lone pair/anion donors): CH_3NH_2, CN^-.
- Therefore the answer is (D).

FINAL: (D) $E = SO_3, Cl^+, H_3O^+, BH_3; N = CH_3NH_2, CN^-$

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: D

A **E = SO_3, Cl^+, BH_3; N = CH_3NH_2, H_3O^+, CN^-**

Why (D) is the key — Electrophiles (electron-deficient): SO_3, Cl^+, H_3O^+ (proton source), BH_3 (empty p orbital). Nucleophiles (lone pair/anion donors): CH_3NH_2, CN^-.

B **E = Cl^+, H_3O^+; N = SO_3, CH_3NH_2, BH_3, CN^-**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

C **E = Cl^+, H_3O^+, BH_3; N = SO_3, CH_3NH_2, H_3O^+, CN^-**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q5

In the reaction, mathrmPh_3P xrightarrowMeI [X] xrightarrown-BuLi [Y], the compounds X and Y, respectively are

A mathrm[$Ph_3P(Me)I$]; $Ph_3P=CH\text{-}CH_2\text{-}CH_3$

B mathrm[$Ph_3P(Me)$][I]; $Ph_3P=CH_2$

C mathrm[$Ph_3P(Me)_2$]; $Ph_3P=CH_2$

D [$Ph_3P(Me)$][I]; Ph_3P

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B mathrm[Ph₃P(Me)][I]; Ph₃P=CH₂

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Ph_3P + MeI → methyltriphenylphosphonium iodide $[Ph_3PMe]^+I^-$ (X); n-BuLi deprotonates it to the Wittig ylide $Ph_3P=CH_2$ (Y).
- Therefore the answer is (B).

FINAL: (B) mathrm[Ph₃P(Me)][I]; Ph₃P=CH₂

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A

mathrm[$Ph_3P(Me)I$]; $Ph_3P=CH-CH_2-CH_3$

Why (B) is the key — Ph_3P + MeI → methyltriphenylphosphonium iodide $[Ph_3PMe]^+I^-$ (X); n-BuLi deprotonates it to the Wittig ylide $Ph_3P=CH_2$ (Y).

C

mathrm[$Ph_3P(Me)_2$]; $Ph_3P=CH_2$

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D

[$Ph_3P(Me)$][I]; Ph_3P

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q6

The decreasing order of nucleophilicity for the following anions is $CH_3CO_2^-$, CH_3O^-, $C_6H_4O^-$, NO_3^-

A $CH_3CO_2^- > CH_3O^- > C_6H_5O^- > NO_3^-$

B $CH_3O^- > NO_3^- > C_6H_5O^- > CH_3CO_2^-$

C $CH_3O^- > C_6H_5O^- > CH_3CO_2^- > NO_3^-$

D $C_6H_5O^- > CH_3O^- > NO_3^- > CH_3CO_2^-$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer C $CH_3O^- > C_6H_5O^- > CH_3CO_2^- > NO_3^-$

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Nucleophilicity tracks basicity for these O-anions: CH_3O^- (pKa 16) > $C_6H_5O^-$ (10) > $CH_3CO_2^-$ (4.8) > NO_3^- (−1.4).
- Therefore the answer is (C).

FINAL: (C) $CH_3O^- > C_6H_5O^- > CH_3CO_2^- > NO_3^-$

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: C

A $CH_3CO_2^- > CH_3O^- > C_6H_5O^- > NO_3^-$

Why (C) is the key — Nucleophilicity tracks basicity for these O-anions: CH_3O^- (pKa 16) > $C_6H_5O^-$ (10) > $CH_3CO_2^-$ (4.8) > NO_3^- (−1.4).

B $CH_3O^- > NO_3^- > C_6H_5O^- > CH_3CO_2^-$

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D $C_6H_5O^- > CH_3O^- > NO_3^- > CH_3CO_2^-$

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q7

The major product obtained in the following reaction, is $H\text{-}C\equiv C\text{-}CH_2OH \xrightarrow[\text{(ii) } C_2H_5Br \text{ (1 equiv.)}]{\text{(i) } LiNH_2 \text{ (2 equiv.)/liq. } NH_3} \text{(iii) } H_3O^+$

A $H_3\ CH_2\ C\text{-}C \equiv C\text{-}CH_2\ OH$

B $H\text{-}C \equiv C\text{-}CH_2\ OCH_2\ CH_3$

C $H_3\ CH_2\ C\text{-}C \equiv C\text{-}CH_2\ NH_2$

D $H\text{-}C \equiv C\text{-}CH_2\ NH\text{-}CH_2\ CH_3$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer A $H_3CH_2C\text{-}C \equiv C\text{-}CH_2OH$

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Two equivalents of $LiNH_2$ deprotonate both the OH and the terminal C–H; the acetylide (the more nucleophilic anion) is ethylated by one equivalent of EtBr, giving 2-pentyn-1-ol, $CH_3CH_2C{\equiv}C{-}CH_2OH$ (a).
- Therefore the answer is (A).

FINAL: (A) $H_3CH_2C\text{-}C \equiv C\text{-}CH_2OH$

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: A

B **H-C ≡ C-CH_2 OCH_2 CH_3**

Why (A) is the key — Two equivalents of $LiNH_2$ deprotonate both the OH and the terminal C–H; the acetylide (the more nucleophilic anion) is ethylated by one equivalent of EtBr, giving 2-pentyn-1-ol, $CH_3CH_2C{\equiv}C–CH_2OH$ (a).

C **H_3 CH_2 C-C ≡ C-CH_2 NH_2**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **H-C ≡ C-CH_2 NH-CH_2 CH_3**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q8

The result of the reduction of either (R) or (S) 2-methylcyclohexanone, in separate reactions, using $LiAlH_4$ is that the reduction of

A. The R enantiomer is stereoselective

B. The R enantiomer is stereospecific

C. The S enantiomer is stereospecific

D. Both the R and S enantiomers is stereoselective

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer D Both the R and S enantiomers is stereoselective

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Hydride adds to either face of the chiral ketone to give unequal amounts of the cis/trans diastereomeric alcohols — a stereoselective (not stereospecific) reduction, and the same is true for both enantiomers.
- Therefore the answer is (D).

FINAL: (D) Both the R and S enantiomers is stereoselective

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: D

A — **The R enantiomer is stereoselective**

Why (D) is the key — Hydride adds to either face of the chiral ketone to give unequal amounts of the cis/trans diastereomeric alcohols — a stereoselective (not stereospecific) reduction, and the same is true for both enantiomers.

B — **The R enantiomer is stereospecific**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

C — **The S enantiomer is stereospecific**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q9

In a company, 35\% of the employees drink coffee, 40\% of the employees drink tea and 10\% of the employees drink both and coffee. What % of employees drink neither tea nor coffee?

A. 35

B. 25

C. 15

D. 40

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer A 35

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Tea or coffee = 35 + 40 − 10 = 65 %; neither = 100 − 65 = 35 %.
- Therefore the answer is (A).

FINAL: (A) 35

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: A

B **25**

Why (A) is the key — Tea or coffee = 35 + 40 − 10 = 65 %; neither = 100 − 65 = 35 %.

C **15**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **40**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q10

The reaction of (+) 2-iodobutane and NaI * (I* is radioactive isotope of iodine) in acetate was studied by measuring the rate of racemization (k_r) and the rate of incorporation of I^*(k_i). (+) CH_3 CH(I) CH_2 CH_3+NaI^* → CH_3 CH(I^*) CH_2 CH_3+NaI For the reaction, the relationship between k_r and k_i is:

A $k_i = 2 \times k_r$

B $k_i = (1 / 2) \times k_r$

C $k_i = k_r$

D $k_i = (1 / 3) \times k_r$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B $k_i=(1/2)\times k_r$

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Each S_N2 exchange inverts one molecule, destroying the rotation of two molecules' worth: $k_r = 2k_i$, so $k_i = ½k_r$ (b).
- Therefore the answer is (B).

FINAL: (B) $k_i=(1/2)\times k_r$

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A $k_i = 2 \times k_r$

Why (B) is the key — Each S_N2 exchange inverts one molecule, destroying the rotation of two molecules' worth: $k_r = 2k_i$, so $k_i = \frac{1}{2}k_r$ (b).

C $k_i = k_r$

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D $k_i = (1 / 3) \times k_r$

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q11

R(-)2-Bromooctane on treatment with aqueous KOH mainly gives 2-octanol that is:

A. Optically active with ‘R’ configuration

B. Optically active with ‘S’ configuration

C. A racemic mixture

D. A meso compound

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B Optically active with ‘S’ configuration

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Secondary alkyl bromide with aqueous KOH (good nucleophile) reacts mainly by S_N2 with Walden inversion: (R)-2-bromooctane → (S)-2-octanol, optically active.
- Therefore the answer is (B).

FINAL: (B) Optically active with ‘S’ configuration

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A **Optically active with ‘R’ configuration**

Why (B) is the key — Secondary alkyl bromide with aqueous KOH (good nucleophile) reacts mainly by S_N2 with Walden inversion: (R)-2-bromooctane → (S)-2-octanol, optically active.

C **A racemic mixture**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **A meso compound**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q12

The rate of nitration of the following aromatic compounds decreases in the order (i) benzene (ii) pyridine (iii) thiophene (iv) toluene

A (iv) > (i) > (iii) > (ii)

B (iii) > (iv) > (i) > (ii)

C (iii) > (ii) > (i) > (iv)

D (ii) > (i) > (iv) > (iii)

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B (iii) > (iv) > (i) > (ii)

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Nitration rate: thiophene > toluene > benzene > pyridine (b).
- Therefore the answer is (B).

FINAL: (B) (iii) > (iv) > (i) > (ii)

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A **(iv) > (i) > (iii) > (ii)**

Why (B) is the key — Nitration rate: thiophene > toluene > benzene > pyridine (b).

C **(iii) > (ii) > (i) > (iv)**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **(ii) > (i) > (iv) > (iii)**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q13

The product of the reaction $C_6H_6+CO+HCl \xrightarrow[]{heat} AlCl_3/Cu_2Cl_2$ gives positive test with Fehling's solution. The product is

A. C_6H_5OH

B. $C_6H_4(Cl)CHO$

C. $C_6H_4(OH)CHO$

D. C_6H_5CHO

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer D C_6H_5CHO

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Gattermann–Koch formylation: benzene + CO/HCl with $AlCl_3/Cu_2Cl_2$ gives benzaldehyde, an aldehyde that reduces Fehling's solution.
- Therefore the answer is (D).

FINAL: (D) C_6H_5CHO

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: D

A C_6H_5OH

Why (D) is the key — Gattermann–Koch formylation: benzene + CO/HCl with $AlCl_3/Cu_2Cl_2$ gives benzaldehyde, an aldehyde that reduces Fehling's solution.

B $C_6H_4(Cl)CHO$

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

C $C_6H_4(OH)CHO$

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q14 The number of possible monoalkylated products formed in the Friedel-Crafts reaction of anisole with 2-chloro-3-methylbutane in the presence of anhydrous $AlCl_3$ at 50^° C is ___
(Numerical answer type — write the value.)

ANSWER: 4

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
2-Chloro-3-methylbutane gives the secondary cation, which rearranges (1,2-H shift) to the tertiary 2-methylbut-2-yl cation. Anisole is o/p-directing: ortho + para products from each cation (unrearranged sec-, rearranged tert-) → 4 monoalkylated products.

Q15

The correct set of reagents required for the following transformation is

A (i) CrO_3; (ii) acrylonitrile; (iii) H_3O^+

B (i) O_2; (ii) methyl acrylate

C (i) CrO_3; (ii) NaOMe/MeOH, methyl acrylate; (iii) H_3O^+

D (i) H_2O; (ii) methyl acrylate

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer C (i) CrO_3; (ii) NaOMe/MeOH, methyl acrylate; (iii) H_3O^+

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- CrO_3 oxidises cyclohexanol to cyclohexanone. NaOMe/MeOH forms the enolate, which undergoes Michael addition to methyl acrylate, giving methyl 3-(2-oxocyclohexyl)propanoate (c).
- Therefore the answer is (C).

FINAL: (C) (i) CrO_3; (ii) NaOMe/MeOH, methyl acrylate; (iii) H_3O^+

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: C

A **(i) CrO_3; (ii) acrylonitrile; (iii) H_3O^+**

Why (C) is the key — CrO_3 oxidises cyclohexanol to cyclohexanone. NaOMe/MeOH forms the enolate, which undergoes Michael addition to methyl acrylate, giving methyl 3-(2-oxocyclohexyl)propanoate (c).

B **(i) O_2; (ii) methyl acrylate**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **(i) H_2O; (ii) methyl acrylate**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q16

Identify the correct reagents required for the following transformation

A (i) $NaBH_4$; (ii) H_3O^+

B (i) $LiAlH_4$; (ii) H_3O^+

C (i) $HOCH_2CH_2OH$, H^+; (ii) $LiAlH_4$ (iii) H_3O^+

D (i) $HSCH_2CH_2SH$, H^+; (ii) $LiAlH_4$; (iii) H_3O^+

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer C (i) $HOCH_2\ CH_2\ OH, H^+$; (ii) $LiAlH_4$ (iii) $H_3\ O^+$

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Protect the aldehyde as an acetal (ethylene glycol/H^+), reduce the ester with $LiAlH_4$, then remove the acetal with aqueous acid (c).
- Therefore the answer is (C).

FINAL: (C) (i) $HOCH_2\ CH_2\ OH, H^+$; (ii) $LiAlH_4$ (iii) $H_3\ O^+$

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: C

A **(i) $NaBH_4$; (ii) H_3O^+**

Why (C) is the key — Protect the aldehyde as an acetal (ethylene glycol/H^+), reduce the ester with $LiAlH_4$, then remove the acetal with aqueous acid (c).

B **(i) $LiAlH_4$; (ii) H_3O^+**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **(i) $HSCH_2CH_2SH$, H^+; (ii) $LiAlH_4$; (iii) H_3O^+**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q17

The appropriate reagents required for carrying out the following transformation are

A (i) succinic anhydride, $AlCl_3$; (ii) Zn/Hg,HCl; (iii) polyphosphoric acid

B (i) maleic anhydride, $AlCl_3$; (ii) $H_2N\text{-}NH_2$,KOH; (iii) H_2SO_4

C (i) succinic anhydride, $FeCl_3$; (ii) $LiAlH_4$; (iii) H_2SO_4

D (i) Phthalic anhydride, $F_3BcdotOEt_2$; (ii) $HS(CH_2)_2SH,H^+$; (iii) Raney Ni; (iv) polyphosphoric acid

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer A (i) succinic anhydride, $AlCl_3$; (ii) Zn/Hg,HCl; (iii) polyphosphoric acid

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Haworth synthesis: (i) Friedel–Crafts succinoylation (succinic anhydride/$AlCl_3$), (ii) Clemmensen reduction (Zn/Hg, HCl) of the keto acid, (iii) intramolecular Friedel–Crafts acylation with polyphosphoric acid to the tetralone.
- Therefore the answer is (A).

FINAL: (A) (i) succinic anhydride, $AlCl_3$; (ii) Zn/Hg,HCl; (iii) polyphosphoric acid

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: A

B

(i) maleic anhydride, $AlCl_3$; (ii) $H_2N\text{-}NH_2$,KOH; (iii) H_2SO_4

Why (A) is the key — Haworth synthesis: (i) Friedel–Crafts succinoylation (succinic anhydride/$AlCl_3$), (ii) Clemmensen reduction (Zn/Hg, HCl) of the keto acid, (iii) intramolecular Friedel–Crafts acylation with polyphosphoric acid to the tetralone.

C

(i) succinic anhydride, $FeCl_3$; (ii) $LiAlH_4$; (iii) H_2SO_4

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D

(i) Phthalic anhydride, $F_3BcdotOEt_2$; (ii) $HS(CH_2)_2SH,H^+$; (iii) Raney Ni; (iv) polyphosphoric acid

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q18

The following conversion is carried out using



(A) hydroboration oxidation followed by Jones oxidation

(B) Wacker oxidation followed by haloform reaction

(C) oxymercuration-determination followed by Jones oxidation

(D) ozonolysis followed by haloform reaction

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Reagents, Reaction Mechanisms & Named Reactions

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B Wacker oxidation followed by haloform reaction

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Wacker oxidation turns the terminal alkene into the methyl ketone $PhCH(Me)COCH_3$. The haloform reaction then removes CH_3, giving 2-phenylpropanoic acid (b).
- Therefore the answer is (B).

FINAL: (B) Wacker oxidation followed by haloform reaction

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A **hydroboration oxidation followed by Jones oxidation**

Why (B) is the key — Wacker oxidation turns the terminal alkene into the methyl ketone $PhCH(Me)COCH_3$. The haloform reaction then removes CH_3, giving 2-phenylpropanoic acid (b).

C **oxymercuration-determination followed by Jones oxidation**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **ozonolysis followed by haloform reaction**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

TOPIC REVISION

Reagents, Reaction Mechanisms & Named Reactions

18 PYQs · Last-minute revision

TOPIC SUMMARY

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

IMPORTANT FORMULA SHEET

- Baeyer–Villiger migration: 3° > cyclohexyl > 2° ≈ benzyl ≈ phenyl > 1° > methyl
- Beckmann: anti group migrates
- Hofmann/Curtius: R–CO–X → R–NH_2 (one carbon fewer)
- Wittig: unstabilised ylide → Z; stabilised → E; HWE → E

FREQUENTLY ASKED CONCEPTS

- Predict the product with stereochemistry
- Which group migrates in rearrangements
- Reagent for a specific transformation (selective reduction/oxidation)
- Mechanism type and intermediates

COMMON MISTAKES & QUICK NOTES

Watch out:
Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.
Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18

Expect 6 question(s) next session on Reagents, Reaction Mechanisms & Named Reactions.

TOPIC 2

Reagents, Named Reactions & Pericyclic – General

6 questions · Easy 1 | Medium 4 | Hard 1 · PYQ frequency: High

Q19

E1cb mechanism is followed in the reaction of:

(A) 2-bromopentane with t-BuOK to give pent-2-ene

(B) Nitromethane with benzaldehyde in the presence of KOH to give β-styrene

(C) Bromobenzene with $NaNH_2$ to give aniline

(D) P-chloronitrobenzene with NaOMe to give p-nitroanisole

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Reagents, Named Reactions & Pericyclic – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B Nitromethane with benzaldehyde in the presence of KOH to give β-styrene

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Dehydration of the nitroaldol (Henry) product goes through the stabilised nitronate carbanion — E1cB (b).
- Therefore the answer is (B).

FINAL: (B) Nitromethane with benzaldehyde in the presence of KOH to give β-styrene

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A **2-bromopentane with t-BuOK to give pent-2-ene**

Why (B) is the key — Dehydration of the nitroaldol (Henry) product goes through the stabilised nitronate carbanion — E1cB (b).

C **Bromobenzene with $NaNH_2$ to give aniline**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **P-chloronitrobenzene with NaOMe to give p-nitroanisole**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q20

The number of nodes present in the highest occupied molecular orbital of 1,3,5-hexatriene in its ground state is

A. one

B. two

C. three

D. four

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Named Reactions & Pericyclic – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B two

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- 1,3,5-Hexatriene has six π-MOs ψ_1–ψ_6 with 0–5 nodes. Six π electrons fill ψ_1–ψ_3; the HOMO ψ_3 has two nodes.
- Therefore the answer is (B).

FINAL: (B) two

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A **one**

Why (B) is the key — 1,3,5-Hexatriene has six π-MOs ψ_1–ψ_6 with 0–5 nodes. Six π electrons fill ψ_1–ψ_3; the HOMO ψ_3 has two nodes.

C **three**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **four**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q21

The concerted photochemical reaction between two olefins leading to a cyclobutane ring is:

A. $\pi\ 2_s + \pi\ 2_a$ cycloaddition

B. $\pi\ 2_s + \pi\ 2_s$ cycloaddition

C. $\sigma\ 2_s + \sigma\ 2_s$ cycloaddition

D. $\pi\ 2_s + \sigma\ 2_a$ cycloaddition

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Named Reactions & Pericyclic – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer B π 2_s + π 2_s cycloaddition

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Consider the π molecular orbitals (MO) of the olefins, HOMO (π) – the bonding MO and the LUMO (π*) anti-bonding molecular orbital (MO). The electronic transition takes place between HOMO of one alkene and LUMO of other alkene under photochemical conditions only. The molecular orbital diagram given below gives a better understanding. Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (B).

FINAL: (B) π 2_s + π 2_s cycloaddition

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: B

A

π 2_s + π 2_a cycloaddition

Why (B) is the key — Consider the π molecular orbitals (MO) of the olefins, HOMO (π) – the bonding MO and the LUMO (π*) anti-bonding molecular orbital (MO). The electronic transition takes place between HOMO of one alkene and LUMO of other alkene under photochemical conditions only. The molecular orbital diagram given below gives a better understanding. Explanation as extracted from the printed page; notation may be imperfect.

C

σ 2_s + σ 2_s cycloaddition

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D

π 2_s + σ 2_a cycloaddition

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q22

In a Diels-Alder reaction, the most reactive diene amongst the following is

A. (4E)-1, 4-hexadiene

B. (4Z)-1, 4-hexadiene

C. (2E, 4E)-2, 4-hexadiene

D. (2Z, 4Z)-2, 4-hexadiene

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Reagents, Named Reactions & Pericyclic – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer C (2E, 4E)-2, 4-hexadiene

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Only conjugated dienes react; (2E,4E)-hexadiene adopts the s-cis conformation easily, whereas the (2Z,4Z) isomer suffers severe steric clash in s-cis. The 1,4-dienes are not conjugated.
- Therefore the answer is (C).

FINAL: (C) (2E, 4E)-2, 4-hexadiene

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: C

A **(4E)-1, 4-hexadiene**

Why (C) is the key — Only conjugated dienes react; (2E,4E)-hexadiene adopts the s-cis conformation easily, whereas the (2Z,4Z) isomer suffers severe steric clash in s-cis. The 1,4-dienes are not conjugated.

B **(4Z)-1, 4-hexadiene**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **(2Z, 4Z)-2, 4-hexadiene**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q23

The frontier orbital interactions involved in the formation of the carbocation intermediate in the reaction of isobutylene with HCl are

A. π of olefin and σ^* of HCl

B. π of olefin and σ of HCl

C. π^* of olefin and σ^* of HCl

D. π^* of olefin and σ of HCl

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Named Reactions & Pericyclic – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Migrate the most substituted, retain configuration'.

Correct Answer A π of olefin and σ^* of HCl

CONCEPT

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

LOGIC / WORKING

- Protonation of the alkene: the filled π (HOMO of isobutylene) donates into the empty σ* of H–Cl (LUMO), forming the C–H bond and the tert-butyl cation.
- Therefore the answer is (A).

FINAL: (A) π of olefin and σ^* of HCl

SHORTCUT / EXAM TRICK

Rearrangements migrate the group best able to stabilise positive charge, keeping its configuration.

COMMON MISTAKE

Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

EXAM TIP

Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MEMORY TRICK

'Migrate the most substituted, retain configuration'.

Why the Other Options Are Wrong

Correct answer: A

B **π of olefin and σ of HCl**

Why (A) is the key — Protonation of the alkene: the filled π (HOMO of isobutylene) donates into the empty σ* of H–Cl (LUMO), forming the C–H bond and the tert-butyl cation.

C **π^* of olefin and σ^* of HCl**

Ruled out: Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.

D **π^* of olefin and σ of HCl**

Ruled out: Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

Q24

In a 400 MHz ^1H NMR spectrometer, a proton resonates at 1560 Hz higher than that of tetramethylsilane. The chemical shift value of this proton is ___ ppm (Round off to one decimal place). (Chemical shift of tetramethylsilane is fixed at zero ppm) (Numerical answer type — write the value.)

ANSWER: 3.9 ppm

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Reagents, Named Reactions & Pericyclic – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
$\delta = \Delta\nu/\nu_0 = 1560\ Hz/400\ MHz = 3.9\ ppm.$

TOPIC REVISION

Reagents, Named Reactions & Pericyclic – General

6 PYQs · Last-minute revision

TOPIC SUMMARY

Named reactions and reagents: Aldol/Claisen/Dieckmann, Michael–Robinson annulation, Wittig/HWE, Grignard/organolithium, Diels–Alder, Friedel–Crafts, Baeyer–Villiger, Beckmann, Hofmann/Curtius/Schmidt/Lossen, Cannizzaro, Favorskii, Mannich, Stork enamine, Sharpless, Swern/DMP/PCC oxidations, Clemmensen/Wolff–Kishner reductions, hydroboration, ozonolysis, Simmons–Smith, Birch, Suzuki/Heck/Sonogashira couplings.

IMPORTANT FORMULA SHEET

- Baeyer–Villiger migration: 3° > cyclohexyl > 2° ≈ benzyl ≈ phenyl > 1° > methyl
- Beckmann: anti group migrates
- Hofmann/Curtius: R–CO–X → R–NH_2 (one carbon fewer)
- Wittig: unstabilised ylide → Z; stabilised → E; HWE → E

FREQUENTLY ASKED CONCEPTS

- Predict the product with stereochemistry
- Which group migrates in rearrangements
- Reagent for a specific transformation (selective reduction/oxidation)
- Mechanism type and intermediates

COMMON MISTAKES & QUICK NOTES

Watch out:
Forgetting that Clemmensen needs acid (base-sensitive substrates → Wolff–Kishner) and vice versa.
Ozonolysis workup decides the product: Me_2S/Zn → aldehydes; H_2O_2 → acids; $NaBH_4$ → alcohols.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q19 Q20 Q21 Q22 Q23 Q24

Expect 1 question(s) next session on Reagents, Named Reactions & Pericyclic – General.

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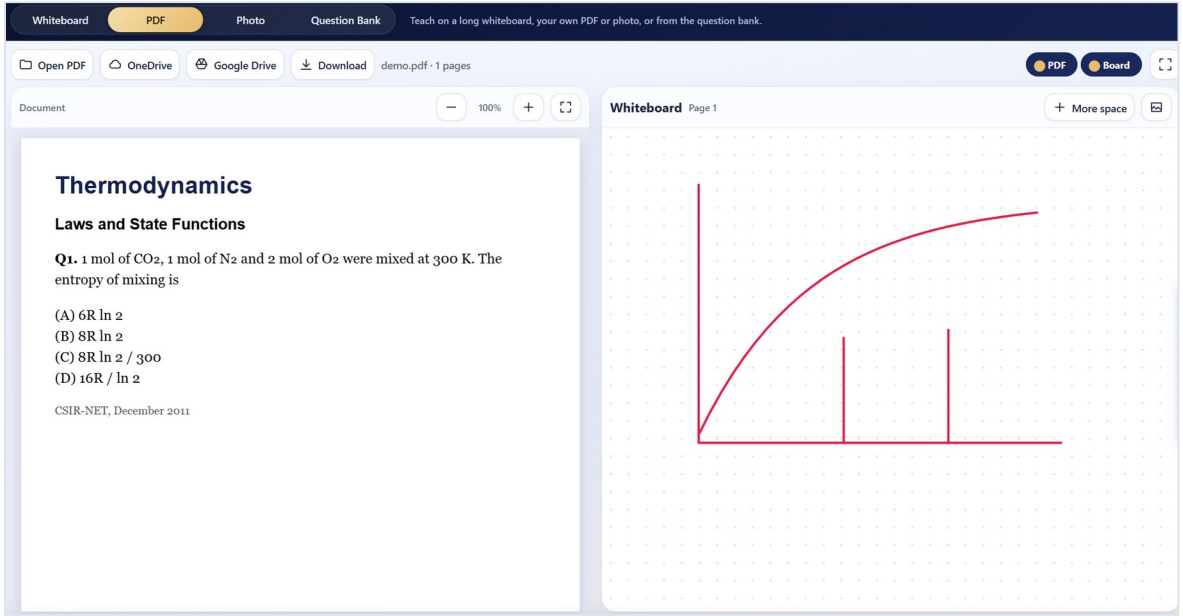
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