ABC CHEMISTRY

Mr. Aniket Bhardwaj · 15+ Years Mentorship

General Organic Chemistry

Premium CSIR-NET PYQ Book

36 Previous-Year Questions · 35 with verified answers · Distractor Analysis

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

CSIR-NET · GATE · IIT-JAM — 5 Topics · 36 Real PYQs

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Course Contents

5 Topics · 36 PYQs

1	Stereochemistry R S E Z	9 Qs E 0 · M 9 · H 0	25%
2	Nomenclature Polycyclics	6 Qs E 0 · M 6 · H 0	17%
3	Acidity Basicity	5 Qs E 1 · M 0 · H 4	14%
4	Aromaticity	4 Qs E 1 · M 2 · H 1	11%
5	General Organic Chemistry – General	12 Qs E 1 · M 9 · H 2	33%

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

TOPIC 1

Stereochemistry R S E Z

9 questions · Easy 0 | Medium 9 | Hard 0 · PYQ frequency: High

Q1

The absolute configuration at the two chiral centres of (-)-camphore is:

A. 1R, 4R

B. 1R, 4S

C. 1S, 4R

D. 1S, 4S

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer D 1S, 4S

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- (−)-Camphor is (1S,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-one; the natural (+)-enantiomer is (1R,4R).
- Therefore the answer is (D).

FINAL: (D) 1S, 4S

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: D

A **1R, 4R**

Why (D) is the key — (−)-Camphor is (1S,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-one; the natural (+)-enantiomer is (1R,4R).

B **1R, 4S**

Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

C **1S, 4R**

Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

Q2

The correct statement about the following molecule is

A. Molecular is chiral and possesses a chiral plane

B. Molecule is chiral and possesses a chiral axis

C. Molecule is achiral as it possesses a plane of symmetry

D. Molecule is achiral as it possesses a centre of symmetry

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer A Molecular is chiral and possesses a chiral plane

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- The molecule is a [2.2]paracyclophane with two Br atoms on one deck, para to each other (one on each side of the ring). The only symmetry element is a C_2 axis through the two ring centres; there is no mirror plane and no centre of symmetry, because the second deck rules them out. The molecule is therefore chiral, and its chirality element is a chiral plane (the substituted benzene deck), so this is planar chirality (a).
- Therefore the answer is (A).

FINAL: (A) Molecular is chiral and possesses a chiral plane

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: A

B — **Molecule is chiral and possesses a chiral axis**

Why (A) is the key — The molecule is a [2.2]paracyclophane with two Br atoms on one deck, para to each other (one on each side of the ring). The only symmetry element is a C_2 axis through the two ring centres; there is no mirror plane and no centre of symmetry, because the second deck rules them out. The molecule is therefore chiral, and its chirality element is a chiral plane (the substituted benzene deck), so this is planar chirality (a).

C — **Molecule is achiral as it possesses a plane of symmetry**

Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

D — **Molecule is achiral as it possesses a centre of symmetry**

Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

Q3

The absolute configuration of the two stereogenic (chiral) centres in the following molecule is

A. 5R, 6R

B. 5R, 6S

C. 5S 6R

D. 5S, 6S

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer C 5S 6R

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- The ketone carbon is C-1, and C-2 carries the ring methyl with the C2=C3 double bond. The stereocentres are C-5 (isopropenyl) and C-6 (methyl + ethyl). C-5: priorities are C-6 (C,C,C; it leads on to C-1 with O,O,C) > isopropenyl (C,C,C) > C-4 (C,H,H) > H. The isopropenyl is hashed, so H points toward the viewer. C-6 → isopropenyl → C-4 runs clockwise, which reverses to 5S. C-6: priorities are C-1 (O,O,C) > C-5 (C,C,H) > CH_2CH_3 > CH_3. CH_3 is on the wedge (toward the viewer). C-1 → C-5 → ethyl runs counterclockwise, which reverses to 6R. Answer: 5S, 6R (c).
- Therefore the answer is (C).

FINAL: (C) 5S 6R

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: C

A **5R, 6R**

Why (C) is the key — The ketone carbon is C-1, and C-2 carries the ring methyl with the C2=C3 double bond. The stereocentres are C-5 (isopropenyl) and C-6 (methyl + ethyl). C-5: priorities are C-6 (C,C,C; it leads on to C-1 with O,O,C) > isopropenyl (C,C,C) > C-4 (C,H,H) > H. The isopropenyl is hashed, so H points toward the viewer. C-6 → isopropenyl → C-4 runs clockwise, which reverses to 5S. C-6: priorities are C-1 (O,O,C) > C-5 (C,C,H) > CH_2CH_3 > CH_3. CH_3 is on the wedge (toward the viewer). C-1 → C-5 → ethyl runs counterclockwise, which reverses to 6R. Answer: 5S, 6R (c).

B **5R, 6S**

Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

D **5S, 6S**

Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

Q4

The correct statement about the following compound is

A. compound is chiral and has P configuration

B. compound is chiral and has M configuration

C. compound is achiral as it possess C_2-axis of symmetry

D. compound is achiral as it possess plane of symmetry

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer A compound is chiral and has P configuration

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- Compound is chiral and has P configuration as it is clockwise path. Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (A).

FINAL: (A) compound is chiral and has P configuration

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: A

B — **compound is chiral and has M configuration**

Why (A) is the key — Compound is chiral and has P configuration as it is clockwise path. Explanation as extracted from the printed page; notation may be imperfect.

C — **compound is achiral as it possess C_2-axis of symmetry**

Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

D — **compound is achiral as it possess plane of symmetry**

Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

Q5

Oxidation of A with mathrmHNO_3/H_2O provides the product (s), which is (are) A

A. Optically active as it is racemic mixture

B. Optically inactive as it is meso

C. Optically active as it is a single diastereomer

D. Optically active as it is a single enantiomer

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer B Optically inactive as it is meso

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- HNO_3 oxidises both ends to COOH. The zig-zag aldotetrose with its two OH groups on opposite wedge/hash gives the tartaric acid with an internal mirror plane: meso, optically inactive (b).
- Therefore the answer is (B).

FINAL: (B) Optically inactive as it is meso

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: B

A — **Optically active as it is racemic mixture**

Why (B) is the key — HNO_3 oxidises both ends to COOH. The zig-zag aldotetrose with its two OH groups on opposite wedge/hash gives the tartaric acid with an internal mirror plane: meso, optically inactive (b).

C — **Optically active as it is a single diastereomer**

Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

D — **Optically active as it is a single enantiomer**

Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

Q6

Among the following, the optically active compound is (a) (b) (c) (d)

SELF-PRACTICE answer on record: (D) — options were not printed in the source.

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Q7

An optically active compound enriched with R-enantiomer (60% ee) exhibited [α]_D+90^°. If the [α]_D value of the sample is -135^°, the ratio of R and S enantiomers would be

A. R: S=1: 19

B. R: S=19: 1

C. R: S=1: 9

D. R: S=9: 1

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer A R: S=1: 19

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- [α] of the pure enantiomer = 90/0.60 = 150°. A sample with −135° has 90 % ee of S: S = 95 %, R = 5 %, i.e. R : S = 1 : 19.
- Therefore the answer is (A).

FINAL: (A) R: S=1: 19

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: A

B

R: S=19: 1

Why (A) is the key — [α] of the pure enantiomer = 90/0.60 = 150°. A sample with −135° has 90 % ee of S: S = 95 %, R = 5 %, i.e. R : S = 1 : 19.

C

R: S=1: 9

Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

D

R: S=9: 1

Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

Q8

Epoxidation of (R)-cyclohex-2-enol with peracetic acid yields a 95:5 mixture of compounds A and B. Compounds A and B are

A. Enantiomers

B. Diastereomers

C. Constitutional isomers

D. Homomers

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer B Diastereomers

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- Epoxidation on the two faces of the chiral alkene gives the syn (OH-directed, major) and anti epoxides: same connectivity, different relative configuration — diastereomers.
- Therefore the answer is (B).

FINAL: (B) Diastereomers

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: B

A — **Enantiomers**

Why (B) is the key — Epoxidation on the two faces of the chiral alkene gives the syn (OH-directed, major) and anti epoxides: same connectivity, different relative configuration — diastereomers.

C — **Constitutional isomers**

Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

D — **Homomers**

Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

Q9

The correct relation between the following compounds is

A. enantiomers

B. diastereomers

C. homomers (identical)

D. constitutional isomers

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Stereochemistry R S E Z

PYQ FREQUENCY
High · 7 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Clockwise = R when #4 is away'.

Correct Answer C homomers (identical)

CONCEPT

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

↓

LOGIC / WORKING

- A 180^° rotation along the bond results in an identical structure.
- Therefore the answer is (C).

FINAL: (C) homomers (identical)

SHORTCUT / EXAM TRICK

If the lowest-priority group points toward you, read the sequence and reverse the answer.

COMMON MISTAKE

Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

EXAM TIP

Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MEMORY TRICK

'Clockwise = R when #4 is away'.

Why the Other Options Are Wrong

Correct answer: C

A **enantiomers**
Why (C) is the key — A 180^° rotation along the bond results in an identical structure.

B **diastereomers**
Ruled out: Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.

D **constitutional isomers**
Ruled out: Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

TOPIC REVISION

Stereochemistry R S E Z

9 PYQs · Last-minute revision

TOPIC SUMMARY

CIP priorities (atomic number, then outward exploration, duplicated atoms for multiple bonds); R/S with lowest priority away; E/Z for alkenes; axial chirality (allenes, biphenyls: Ra/Sa, M/P), planar chirality; meso compounds; enantiomers vs diastereomers; Fischer projection rules (even swaps keep configuration).

IMPORTANT FORMULA SHEET

- Max stereoisomers = 2^n (fewer with meso forms)
- Fischer: horizontal = toward viewer; two swaps = same configuration; lowest priority horizontal → reverse the read
- Specific rotation $[\alpha] = \alpha/(l\ c)$

FREQUENTLY ASKED CONCEPTS

- Assign R/S, E/Z in tricky cases (isotopes, rings)
- Count stereoisomers
- Identify meso, enantiomer, diastereomer pairs
- Allene chirality

COMMON MISTAKES & QUICK NOTES

Watch out:
Ranking by group size instead of atomic number at the first point of difference; forgetting duplicate atoms for C=O.
Allenes with two different substituents on each end are chiral (axial), though they have no stereocentre.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9

Expect 1 question(s) next session on Stereochemistry R S E Z.

TOPIC 2

Nomenclature Polycyclics

6 questions · Easy 0 | Medium 6 | Hard 0 · PYQ frequency: High

Q10

The IUPAC name of the compound given below is

A. (2E, 4E)-3-chlorohexa-2, 4-diene-1, 6-diol

B. (2Z, 4E)-3-chlorohexa-2, 4-diene-1, 6-diol

C. (2Z, 4Z)-4-chlorohexa-2, 4-diene-1, 6-diol

D. (2E, 4Z)-4-chlorohexa-2, 4-diene-1, 6-diol

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Nomenclature Polycyclics

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Big bridge first, bridgehead start'.

Correct Answer B (2Z, 4E)-3-chlorohexa-2, 4-diene-1, 6-diol

CONCEPT

Von Baeyer bicyclo[x.y.z] (bridgeheads, longest bridges first), spiro[x.y] (smaller ring first), numbering from a bridgehead along the longest bridge; fused aromatic nomenclature (naphthalene, anthracene, phenanthrene positions α/β, peri), heterocycles (Hantzsch–Widman).

↓

LOGIC / WORKING

- Number from the end that gives Cl the lowest locant: $HOCH_2$(1)–CH(2)=C(Cl)(3)–CH(4)=CH(5)–CH_2OH(6), so the name is 3-chlorohexa-2,4-diene-1,6-diol (this rules out options c and d). C2=C3: on C-2, CH_2OH > H; on C-3, Cl > C-4. CH_2OH and Cl are drawn on the same (lower) side, so this bond is 2Z. C4=C5: on C-4, C-3 > H; on C-5, CH_2OH > H. C-3 (lower) and CH_2OH (upper) are on opposite sides, so this bond is 4E. Answer: (2Z,4E)-3-chlorohexa-2,4-diene-1,6-diol (b).
- Therefore the answer is (B).

FINAL: (B) (2Z, 4E)-3-chlorohexa-2, 4-diene-1, 6-diol

SHORTCUT / EXAM TRICK

Bridges listed in decreasing size; numbering starts at a bridgehead and runs round the largest bridge first.

COMMON MISTAKE

Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

EXAM TIP

Adamantane = tricyclo[3.3.1.$1^{3,7}$]decane.

MEMORY TRICK

'Big bridge first, bridgehead start'.

Why the Other Options Are Wrong

Correct answer: B

A **(2E, 4E)-3-chlorohexa-2, 4-diene-1, 6-diol**

Why (B) is the key — Number from the end that gives Cl the lowest locant: $HOCH_2$(1)–CH(2)=C(Cl)(3)–CH(4)=CH(5)–CH_2OH(6), so the name is 3-chlorohexa-2,4-diene-1,6-diol (this rules out options c and d). C2=C3: on C-2, CH_2OH > H; on C-3, Cl > C-4. CH_2OH and Cl are drawn on the same (lower) side, so this bond is 2Z. C4=C5: on C-4, C-3 > H; on C-5, CH_2OH > H. C-3 (lower) and CH_2OH (upper) are on opposite sides, so this bond is 4E. Answer: (2Z,4E)-3-chlorohexa-2,4-diene-1,6-diol (b).

C **(2Z, 4Z)-4-chlorohexa-2, 4-diene-1, 6-diol**

Ruled out: Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

D **(2E, 4Z)-4-chlorohexa-2, 4-diene-1, 6-diol**

Ruled out: Adamantane = tricyclo[3.3.1.$1^{3,7}$]decane.

Q11

The IUPAC name of the following compound is

A. (R)-3- (prop-2-enyl) hex-5-ynoic acid

B. (S)-3- (prop-2-enyl) hex-5-ynoic acid

C. (R)-3- (prop-2-enyl) hex-5-enoic acid

D. (S)-3- (prop-2-ynyl) hex-5- enoic acid

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Nomenclature Polycyclics

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Big bridge first, bridgehead start'.

Correct Answer D (S)-3- (prop-2-ynyl) hex-5- enoic acid

CONCEPT

Von Baeyer bicyclo[x.y.z] (bridgeheads, longest bridges first), spiro[x.y] (smaller ring first), numbering from a bridgehead along the longest bridge; fused aromatic nomenclature (naphthalene, anthracene, phenanthrene positions α/β, peri), heterocycles (Hantzsch–Widman).

↓

LOGIC / WORKING

- The principal chain carries COOH and the maximum number of multiple bonds; with a tie, double bonds are preferred in the chain. That gives hex-5-enoic acid with a prop-2-ynyl group at C-3. The stereocentre is S (d).
- Therefore the answer is (D).

FINAL: (D) (S)-3- (prop-2-ynyl) hex-5- enoic acid

SHORTCUT / EXAM TRICK

Bridges listed in decreasing size; numbering starts at a bridgehead and runs round the largest bridge first.

COMMON MISTAKE

Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

EXAM TIP

Adamantane = tricyclo[3.3.1.1^{3,7}]decane.

MEMORY TRICK

'Big bridge first, bridgehead start'.

Why the Other Options Are Wrong

Correct answer: D

A **(R)-3- (prop-2-enyl) hex-5-ynoic acid**

Why (D) is the key — The principal chain carries COOH and the maximum number of multiple bonds; with a tie, double bonds are preferred in the chain. That gives hex-5-enoic acid with a prop-2-ynyl group at C-3. The stereocentre is S (d).

B **(S)-3- (prop-2-enyl) hex-5-ynoic acid**

Ruled out: Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

C **(R)-3- (prop-2-enyl) hex-5-enoic acid**

Ruled out: Adamantane = tricyclo[3.3.1.$1^{3,7}$]decane.

Q12

The IUPAC name of the compound given below is:

(A) ethyl (R)-2-methyl-4-oxocyclohex-2-enecarboxylate

(B) ethyl (S)-2-methyl-4-oxocyclohex-2-enecarboxylate

(C) (R)-4-ethoxycarbonyl-3-methylcyclo-hex-2-enone

(D) (S)-4-ethoxycarbonyl-3-methylcyclo-hex-2-enone

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Nomenclature Polycyclics

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Big bridge first, bridgehead start'.

Correct Answer B ethyl (S)-2-methyl-4-oxocyclohex-2-enecarboxylate

CONCEPT

Von Baeyer bicyclo[x.y.z] (bridgeheads, longest bridges first), spiro[x.y] (smaller ring first), numbering from a bridgehead along the longest bridge; fused aromatic nomenclature (naphthalene, anthracene, phenanthrene positions α/β, peri), heterocycles (Hantzsch–Widman).

↓

LOGIC / WORKING

- The ester outranks the ketone, so the name is ethyl 2-methyl-4-oxocyclohex-2-ene-1-carboxylate. At C-1 (H on a hash) the priorities are COOEt > C-2 > C-6, which run anticlockwise: S (b).
- Therefore the answer is (B).

FINAL: (B) ethyl (S)-2-methyl-4-oxocyclohex-2-enecarboxylate

SHORTCUT / EXAM TRICK

Bridges listed in decreasing size; numbering starts at a bridgehead and runs round the largest bridge first.

COMMON MISTAKE

Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

EXAM TIP

Adamantane = tricyclo[3.3.1.1^{3,7}]decane.

MEMORY TRICK

'Big bridge first, bridgehead start'.

Why the Other Options Are Wrong

Correct answer: B

A — **ethyl (R)-2-methyl-4-oxocyclohex-2-enecarboxylate**

Why (B) is the key — The ester outranks the ketone, so the name is ethyl 2-methyl-4-oxocyclohex-2-ene-1-carboxylate. At C-1 (H on a hash) the priorities are COOEt > C-2 > C-6, which run anticlockwise: S (b).

C — **(R)-4-ethoxycarbonyl-3-methylcyclo-hex-2-enone**

Ruled out: Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

D — **(S)-4-ethoxycarbonyl-3-methylcyclo-hex-2-enone**

Ruled out: Adamantane = tricyclo[3.3.1.$1^{3,7}$]decane.

Q13

The IUPAC name for the compound given below is

A (2R, 3Z)-7-phenylhept-3-en-2-ol

B (2S, 3Z)-7-phenylhept-3-en-2-ol

C (2R, 3E)-7-phenylhept-3-en-2-ol

D (2S, 3E)-7-phenylhept-3-en-2-ol

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Nomenclature Polycyclics

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Big bridge first, bridgehead start'.

Correct Answer D (2S, 3E)-7-phenylhept-3-en-2-ol

CONCEPT

Von Baeyer bicyclo[x.y.z] (bridgeheads, longest bridges first), spiro[x.y] (smaller ring first), numbering from a bridgehead along the longest bridge; fused aromatic nomenclature (naphthalene, anthracene, phenanthrene positions α/β, peri), heterocycles (Hantzsch–Widman).

↓

LOGIC / WORKING

- The C3=C4 double bond of the chain is drawn trans (C-2 and C-5 on opposite sides), so it is 3E. At C-2 the priorities are OH > C-3 (vinyl) > CH_3 > H. OH is on a hash and H points toward the viewer; OH → C-3 → CH_3 runs clockwise, and because H is in front the descriptor reverses to S. Name: (2S,3E)-7-phenylhept-3-en-2-ol (d).
- Therefore the answer is (D).

FINAL: (D) (2S, 3E)-7-phenylhept-3-en-2-ol

SHORTCUT / EXAM TRICK

Bridges listed in decreasing size; numbering starts at a bridgehead and runs round the largest bridge first.

COMMON MISTAKE

Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

EXAM TIP

Adamantane = tricyclo[3.3.1.$1^{3,7}$]decane.

MEMORY TRICK

'Big bridge first, bridgehead start'.

Why the Other Options Are Wrong

Correct answer: D

A **(2R, 3Z)-7-phenylhept-3-en-2-ol**

Why (D) is the key — The C3=C4 double bond of the chain is drawn trans (C-2 and C-5 on opposite sides), so it is 3E. At C-2 the priorities are OH > C-3 (vinyl) > CH_3 > H. OH is on a hash and H points toward the viewer; OH → C-3 → CH_3 runs clockwise, and because H is in front the descriptor reverses to S. Name: (2S,3E)-7-phenylhept-3-en-2-ol (d).

B **(2S, 3Z)-7-phenylhept-3-en-2-ol**

Ruled out: Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

C **(2R, 3E)-7-phenylhept-3-en-2-ol**

Ruled out: Adamantane = tricyclo[3.3.1.$1^{3,7}$]decane.

Q14

The IUPAC name of the following compound is

A. 9-borabicyclo[3.3.1]nonane

B. 1-borabicyclo[3.3.1]nonane

C. 9-borabicyclo[3.3.0]octane

D. 1-borabicyclo[3.3.0]octane

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Nomenclature Polycyclics

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Big bridge first, bridgehead start'.

Correct Answer A 9-borabicyclo[3.3.1]nonane

CONCEPT

Von Baeyer bicyclo[x.y.z] (bridgeheads, longest bridges first), spiro[x.y] (smaller ring first), numbering from a bridgehead along the longest bridge; fused aromatic nomenclature (naphthalene, anthracene, phenanthrene positions α/β, peri), heterocycles (Hantzsch–Widman).

↓

LOGIC / WORKING

- 9-BBN is 9-borabicyclo[3.3.1]nonane: boron at the one-carbon bridge (position 9) of the bicyclo[3.3.1] skeleton.
- Therefore the answer is (A).

FINAL: (A) 9-borabicyclo[3.3.1]nonane

SHORTCUT / EXAM TRICK

Bridges listed in decreasing size; numbering starts at a bridgehead and runs round the largest bridge first.

COMMON MISTAKE

Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

EXAM TIP

Adamantane = tricyclo[3.3.1.1^{3,7}]decane.

MEMORY TRICK

'Big bridge first, bridgehead start'.

Why the Other Options Are Wrong

Correct answer: A

B **1-borabicyclo[3.3.1]nonane**

Why (A) is the key — 9-BBN is 9-borabicyclo[3.3.1]nonane: boron at the one-carbon bridge (position 9) of the bicyclo[3.3.1] skeleton.

C **9-borabicyclo[3.3.0]octane**

Ruled out: Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

D **1-borabicyclo[3.3.0]octane**

Ruled out: Adamantane = tricyclo[3.3.1.$1^{3,7}$]decane.

Q15

IUPAC nomenclature of the following propellane is

A. Tricyclo[1.1.1.0²,4]pentane

B. Tricyclo[1.1.0.1¹,3]pentane

C. Tricyclo[1.1.1¹,3.0¹,5]pentane

D. Tricyclo[1.1.1.0¹,3]pentane

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Nomenclature Polycyclics

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Big bridge first, bridgehead start'.

Correct Answer D Tricyclo[1.1.1.0¹,3]pentane

CONCEPT

Von Baeyer bicyclo[x.y.z] (bridgeheads, longest bridges first), spiro[x.y] (smaller ring first), numbering from a bridgehead along the longest bridge; fused aromatic nomenclature (naphthalene, anthracene, phenanthrene positions α/β, peri), heterocycles (Hantzsch–Widman).

↓

LOGIC / WORKING

- [1.1.1]Propellane: three one-carbon bridges between the two bridgehead carbons that are also bonded to each other — tricyclo[1.1.1.0¹,³]pentane.
- Therefore the answer is (D).

FINAL: (D) Tricyclo[1.1.1.0¹,3]pentane

SHORTCUT / EXAM TRICK

Bridges listed in decreasing size; numbering starts at a bridgehead and runs round the largest bridge first.

COMMON MISTAKE

Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

EXAM TIP

Adamantane = tricyclo[3.3.1.1³,⁷]decane.

MEMORY TRICK

'Big bridge first, bridgehead start'.

Why the Other Options Are Wrong

Correct answer: D

A **Tricyclo[1.1.1.0²,4]pentane**

Why (D) is the key — [1.1.1]Propellane: three one-carbon bridges between the two bridgehead carbons that are also bonded to each other — tricyclo[1.1.1.0¹,³]pentane.

B **Tricyclo[1.1.0.1¹,3]pentane**

Ruled out: Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).

C **Tricyclo[1.1.1¹,3.0¹,5]pentane**

Ruled out: Adamantane = tricyclo[3.3.1.1³,⁷]decane.

TOPIC REVISION

Nomenclature Polycyclics

6 PYQs · Last-minute revision

TOPIC SUMMARY

Von Baeyer bicyclo[x.y.z] (bridgeheads, longest bridges first), spiro[x.y] (smaller ring first), numbering from a bridgehead along the longest bridge; fused aromatic nomenclature (naphthalene, anthracene, phenanthrene positions α/β, peri), heterocycles (Hantzsch–Widman).

IMPORTANT FORMULA SHEET

- bicyclo[2.2.1]heptane = norbornane; bicyclo[2.2.2]octane; spiro[4.5]decane
- Total carbons = x + y + z + 2 (bicyclo); x + y + 1 (spiro)
- Naphthalene: 1,4,5,8 = α; 2,3,6,7 = β

FREQUENTLY ASKED CONCEPTS

- Name a given bridged ring system
- Number of carbons from the name
- α vs β positions in naphthalene
- Hantzsch–Widman suffixes

COMMON MISTAKES & QUICK NOTES

Watch out:
Starting spiro numbering in the larger ring (start in the smaller ring, adjacent to the spiro atom).
Adamantane = tricyclo[3.3.1.1^{3,7}]decane.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q10 Q11 Q12 Q13 Q14 Q15

Expect 1 question(s) next session on Nomenclature Polycyclics.

TOPIC 3

Acidity Basicity

5 questions · Easy 1 | Medium 0 | Hard 4 · PYQ frequency: Occasional

Q16

The correct order of acidity of the compounds A-C is: A B C

A. A > B > C

B. B > C > A

C. C > A > B

D. B > A > C

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Acidity Basicity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Stable conjugate base = strong acid'.

Correct Answer C C > A > B

CONCEPT

Acidity rises with electronegativity, size (down a group), resonance delocalisation, inductive withdrawal (distance-dependent) and s-character; basicity of amines (gas phase vs water solvation; aniline < NH_3 < alkylamines; amidines/guanidines strong; pyridine 5.2, pyrrole non-basic, imidazole 7); ortho effect; aromatic phenol substituent effects.

↓

LOGIC / WORKING

- Squaric acid ($pKa_1 \approx 1.5$) is most acidic. Cyclopentane-1,3-dione (enol, pKa ≈ 4.5) is next. Indane-1,3-dione (pKa ≈ 7) is weakest. C > A > B (c).
- Therefore the answer is (C).

FINAL: (C) C > A > B

SHORTCUT / EXAM TRICK

Resonance beats induction: p-nitrophenol (7.1) is far more acidic than m-nitrophenol (8.4).

COMMON MISTAKE

Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

EXAM TIP

Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

MEMORY TRICK

'Stable conjugate base = strong acid'.

Why the Other Options Are Wrong

Correct answer: C

A

A > B > C

Why (C) is the key — Squaric acid ($pKa_1 \approx 1.5$) is most acidic. Cyclopentane-1,3-dione (enol, pKa ≈ 4.5) is next. Indane-1,3-dione (pKa ≈ 7) is weakest. C > A > B (c).

B

B > C > A

Ruled out: Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

D

B > A > C

Ruled out: Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

Q17

The increasing order of pK_a values of the circled hydrogens in the following compounds is (I) (II) (III)

A. I < II < III

B. I < III < II

C. II < I < III

D. II < III < I

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Acidity Basicity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Stable conjugate base = strong acid'.

Correct Answer C II < I < III

CONCEPT

Acidity rises with electronegativity, size (down a group), resonance delocalisation, inductive withdrawal (distance-dependent) and s-character; basicity of amines (gas phase vs water solvation; aniline < NH_3 < alkylamines; amidines/guanidines strong; pyridine 5.2, pyrrole non-basic, imidazole 7); ortho effect; aromatic phenol substituent effects.

↓

LOGIC / WORKING

- The N–H of the N-cyanoguanidinium salt (II) is strongly acidic. The CH_2 flanked by two carbonyls in I has pKa ≈ 10. The C-2 H of the 1,3-dimethylimidazolium ion (III) has pKa ≈ 21–23. II < I < III (c).
- Therefore the answer is (C).

FINAL: (C) II < I < III

SHORTCUT / EXAM TRICK

Resonance beats induction: p-nitrophenol (7.1) is far more acidic than m-nitrophenol (8.4).

COMMON MISTAKE

Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

EXAM TIP

Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

MEMORY TRICK

'Stable conjugate base = strong acid'.

Why the Other Options Are Wrong

Correct answer: C

A **I < II < III**

Why (C) is the key — The N–H of the N-cyanoguanidinium salt (II) is strongly acidic. The CH_2 flanked by two carbonyls in I has pKa ≈ 10. The C-2 H of the 1,3-dimethylimidazolium ion (III) has pKa ≈ 21–23. II < I < III (c).

B **I < III < II**

Ruled out: Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

D **II < III < I**

Ruled out: Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

Q18

The correct order of acidity of the following compound A-C is:

A. B > C > A

B. C>B>A

C. A > C > B

D. A > B > C

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Acidity Basicity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Stable conjugate base = strong acid'.

Correct Answer C A > C > B

CONCEPT

Acidity rises with electronegativity, size (down a group), resonance delocalisation, inductive withdrawal (distance-dependent) and s-character; basicity of amines (gas phase vs water solvation; aniline < NH_3 < alkylamines; amidines/guanidines strong; pyridine 5.2, pyrrole non-basic, imidazole 7); ortho effect; aromatic phenol substituent effects.

↓

LOGIC / WORKING

- Pentakis(trifluoromethyl)cyclopentadiene (A) is a carbon superacid: five CF_3 groups stabilise the aromatic cyclopentadienide. Pentamethylcyclopentadiene (C, pKa ≈ 26) is next. Cyclopropene (B) is the weakest acid because its conjugate base would be the antiaromatic cyclopropenyl anion. A > C > B.
- Therefore the answer is (C).

FINAL: (C) A > C > B

SHORTCUT / EXAM TRICK

Resonance beats induction: p-nitrophenol (7.1) is far more acidic than m-nitrophenol (8.4).

COMMON MISTAKE

Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

EXAM TIP

Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

MEMORY TRICK

'Stable conjugate base = strong acid'.

Why the Other Options Are Wrong

Correct answer: C

A — **B > C > A**

Why (C) is the key — Pentakis(trifluoromethyl)cyclopentadiene (A) is a carbon superacid: five CF_3 groups stabilise the aromatic cyclopentadienide. Pentamethylcyclopentadiene (C, pKa ≈ 26) is next. Cyclopropene (B) is the weakest acid because its conjugate base would be the antiaromatic cyclopropenyl anion. A > C > B.

B — **C>B>A**

Ruled out: Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

D — **A > B > C**

Ruled out: Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

Q19

Arrange the following in the decreasing order of acidity of the hydrogen indicated in italic (i) CH_3 $COCH_3$ (ii) CH_3 $COCH_2$ $COCH_3$ (iii) CH_3 $OOCCH_2$ $COOCH_3$ (iv) CH_3 $COCH_2$ NO_2

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

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

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

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

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Acidity Basicity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Stable conjugate base = strong acid'.

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

CONCEPT

Acidity rises with electronegativity, size (down a group), resonance delocalisation, inductive withdrawal (distance-dependent) and s-character; basicity of amines (gas phase vs water solvation; aniline < NH_3 < alkylamines; amidines/guanidines strong; pyridine 5.2, pyrrole non-basic, imidazole 7); ortho effect; aromatic phenol substituent effects.

↓

LOGIC / WORKING

- pKa: $CH_3COCH_2NO_2$ (5) < acetylacetone (9) < dimethyl malonate (13) < acetone (19): (iv) > (ii) > (iii) > (i) (b). Chapter list · Next in chapter →
- Therefore the answer is (B).

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

SHORTCUT / EXAM TRICK

Resonance beats induction: p-nitrophenol (7.1) is far more acidic than m-nitrophenol (8.4).

COMMON MISTAKE

Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

EXAM TIP

Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

MEMORY TRICK

'Stable conjugate base = strong acid'.

Why the Other Options Are Wrong

Correct answer: B

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

Why (B) is the key — pKa: $CH_3COCH_2NO_2$ (5) < acetylacetone (9) < dimethyl malonate (13) < acetone (19): (iv) > (ii) > (iii) > (i) (b). Chapter list · Next in chapter →

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

Ruled out: Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

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

Ruled out: Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

Q20

The compound that contains the most acidic hydrogen is

A mathrm$H_2C=CH_2$

B $CH \equiv CH$

C mathrm$H_2C=C=CH_2$

D mathrmH_3C-CH_3

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Acidity Basicity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Stable conjugate base = strong acid'.

Correct Answer B CH ≡ CH

CONCEPT

Acidity rises with electronegativity, size (down a group), resonance delocalisation, inductive withdrawal (distance-dependent) and s-character; basicity of amines (gas phase vs water solvation; aniline < NH_3 < alkylamines; amidines/guanidines strong; pyridine 5.2, pyrrole non-basic, imidazole 7); ortho effect; aromatic phenol substituent effects.

↓

LOGIC / WORKING

- Acidity of C–H follows s-character of the carbanion: sp (acetylene, pK_a 25) > sp^2 (ethylene 44; allene ~44) > sp^3 (ethane 50).
- Therefore the answer is (B).

FINAL: (B) CH ≡ CH

SHORTCUT / EXAM TRICK

Resonance beats induction: p-nitrophenol (7.1) is far more acidic than m-nitrophenol (8.4).

COMMON MISTAKE

Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

EXAM TIP

Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

MEMORY TRICK

'Stable conjugate base = strong acid'.

Why the Other Options Are Wrong

Correct answer: B

A **mathrm$H_2C=CH_2$**

Why (B) is the key — Acidity of C–H follows s-character of the carbanion: sp (acetylene, pK_a 25) > sp^2 (ethylene 44; allene ~44) > sp^3 (ethane 50).

C **mathrm$H_2C=C=CH_2$**

Ruled out: Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).

D **mathrmH_3C-CH_3**

Ruled out: Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

TOPIC REVISION

Acidity Basicity

5 PYQs · Last-minute revision

TOPIC SUMMARY

Acidity rises with electronegativity, size (down a group), resonance delocalisation, inductive withdrawal (distance-dependent) and s-character; basicity of amines (gas phase vs water solvation; aniline < NH_3 < alkylamines; amidines/guanidines strong; pyridine 5.2, pyrrole non-basic, imidazole 7); ortho effect; aromatic phenol substituent effects.

IMPORTANT FORMULA SHEET

- pKa: $HC{\equiv}CH$ 25, H_2O 15.7, EtOH 16, PhOH 10, CH_3COOH 4.8, CF_3COOH 0.2, HCN 9.2
- Conjugate acid pKa: pyridinium 5.2, anilinium 4.6, alkylammonium 10–11, guanidinium 13.6, DBU 12

FREQUENTLY ASKED CONCEPTS

- Rank acids/bases by structure
- Effect of ortho/para nitro on phenol pKa
- Why pyrrole N is not basic
- Gas-phase vs aqueous amine basicity order

COMMON MISTAKES & QUICK NOTES

Watch out:
Protonating pyrrole at N (its lone pair is part of the aromatic sextet; it protonates at C2).
Guanidine is strongly basic because the cation is symmetric and triply resonance-stabilised.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q16 Q17 Q18 Q19 Q20

Expect 1 question(s) next session on Acidity Basicity.

TOPIC 4

Aromaticity

4 questions · Easy 1 | Medium 2 | Hard 1 · PYQ frequency: Occasional

Q21

The correct order for the rates of electrophilic aromatic substitution of the following compound is (I) (II) (III)

A. I > II > III

B. II > I > III

C. III > II > I

D. I > III > II

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Aromaticity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 happy, 4n flat unhappy'.

Correct Answer D I > III > II

CONCEPT

Hückel 4n+2 (aromatic), 4n planar (antiaromatic), non-planar/non-conjugated (non-aromatic); ions (cyclopropenyl$^+$, cyclopentadienyl$^-$, tropylium$^+$), heterocycles (furan, pyrrole, thiophene, pyridine), annulenes ([18] aromatic, [16] antiaromatic), azulene, Möbius aromaticity (4n), NMR ring-current test, Frost circle.

↓

LOGIC / WORKING

- N-Methylindole (π-excessive) ≫ chlorobenzene (mildly deactivated) > pyridine (π-deficient and protonated under SEAr conditions). I > III > II (d).
- Therefore the answer is (D).

FINAL: (D) I > III > II

SHORTCUT / EXAM TRICK

Draw the Frost circle: filled bonding levels with no half-filled degenerate pair = aromatic.

COMMON MISTAKE

Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

EXAM TIP

Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

MEMORY TRICK

'4n+2 happy, 4n flat unhappy'.

Why the Other Options Are Wrong

Correct answer: D

A **I > II > III**

Why (D) is the key — N-Methylindole (π-excessive) ≫ chlorobenzene (mildly deactivated) > pyridine (π-deficient and protonated under SEAr conditions). I > III > II (d).

B **II > I > III**

Ruled out: Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

C **III > II > I**

Ruled out: Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

Q22

The compound that is antiaromatic is (I) (II) (III) (IV)

A I

B II

C III

D IV

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Aromaticity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 happy, 4n flat unhappy'.

Correct Answer A I

CONCEPT

Hückel 4n+2 (aromatic), 4n planar (antiaromatic), non-planar/non-conjugated (non-aromatic); ions (cyclopropenyl$^+$, cyclopentadienyl$^-$, tropylium$^+$), heterocycles (furan, pyrrole, thiophene, pyridine), annulenes ([18] aromatic, [16] antiaromatic), azulene, Möbius aromaticity (4n), NMR ring-current test, Frost circle.

↓

LOGIC / WORKING

- Borole (I, C_4H_4BH) is a planar ring with an empty p orbital on boron. Its cyclic conjugation holds 4π electrons (4n, n = 1), so it is antiaromatic. Barrelene (II, bicyclo[2.2.2]octatriene) has only homoconjugated, non-cyclic π overlap, so it is non-aromatic. Cycloheptatriene (III) is interrupted by an sp^3 CH_2, so it is non-aromatic. Cyclopropenone (IV) polarises to a 2π cyclopropenium ring, so it is aromatic. Answer: (a).
- Therefore the answer is (A).

FINAL: (A) I

SHORTCUT / EXAM TRICK

Draw the Frost circle: filled bonding levels with no half-filled degenerate pair = aromatic.

COMMON MISTAKE

Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

EXAM TIP

Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

MEMORY TRICK

'4n+2 happy, 4n flat unhappy'.

Why the Other Options Are Wrong

Correct answer: A

B — **II**

Why (A) is the key — Borole (I, C_4H_4BH) is a planar ring with an empty p orbital on boron. Its cyclic conjugation holds 4π electrons (4n, n = 1), so it is antiaromatic. Barrelene (II, bicyclo[2.2.2]octatriene) has only homoconjugated, non-cyclic π overlap, so it is non-aromatic. Cycloheptatriene (III) is interrupted by an sp^3 CH_2, so it is non-aromatic. Cyclopropenone (IV) polarises to a 2π cyclopropenium ring, so it is aromatic. Answer: (a).

C — **III**

Ruled out: Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

D — **IV**

Ruled out: Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

Q23

With respect to electrophilic aromatic substitution, reactivity order of pyrrole, pyridine and indole is

A. indole > pyrrole > pyridine

B. pyrrole > pyridine > indole

C. pyrrole > indole > pyridine

D. indole > pyridine > pyrrole

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Aromaticity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'4n+2 happy, 4n flat unhappy'.

Correct Answer C pyrrole > indole > pyridine

CONCEPT

Hückel 4n+2 (aromatic), 4n planar (antiaromatic), non-planar/non-conjugated (non-aromatic); ions (cyclopropenyl$^+$, cyclopentadienyl$^-$, tropylium$^+$), heterocycles (furan, pyrrole, thiophene, pyridine), annulenes ([18] aromatic, [16] antiaromatic), azulene, Möbius aromaticity (4n), NMR ring-current test, Frost circle.

↓

LOGIC / WORKING

- Pyrrole is the most reactive (electron-rich five-membered ring); indole is somewhat less reactive because part of the π density is shared with the benzene ring; pyridine is strongly deactivated (electron-poor, protonated by acids).
- Therefore the answer is (C).

FINAL: (C) pyrrole > indole > pyridine

SHORTCUT / EXAM TRICK

Draw the Frost circle: filled bonding levels with no half-filled degenerate pair = aromatic.

COMMON MISTAKE

Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

EXAM TIP

Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

MEMORY TRICK

'4n+2 happy, 4n flat unhappy'.

Why the Other Options Are Wrong

Correct answer: C

A **indole > pyrrole > pyridine**

Why (C) is the key — Pyrrole is the most reactive (electron-rich five-membered ring); indole is somewhat less reactive because part of the [illegible] density is shared with the benzene ring; pyridine is strongly deactivated (electron-poor, protonated by acids).

B **pyrrole > pyridine > indole**

Ruled out: Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

D **indole > pyridine > pyrrole**

Ruled out: Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

Q24

The value of 'n' for the following molecule according to Huckel's rule is

A. 16

B. 4

C. 3

D. 14

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Aromaticity

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'4n+2 happy, 4n flat unhappy'.

Correct Answer C 3

CONCEPT

Hückel 4n+2 (aromatic), 4n planar (antiaromatic), non-planar/non-conjugated (non-aromatic); ions (cyclopropenyl$^+$, cyclopentadienyl$^-$, tropylium$^+$), heterocycles (furan, pyrrole, thiophene, pyridine), annulenes ([18] aromatic, [16] antiaromatic), azulene, Möbius aromaticity (4n), NMR ring-current test, Frost circle.

↓

LOGIC / WORKING

- Pyrene has 16 π electrons, but its aromatic periphery carries 14 π: 4n + 2 = 14 → n = 3 (c).
- Therefore the answer is (C).

FINAL: (C) 3

SHORTCUT / EXAM TRICK

Draw the Frost circle: filled bonding levels with no half-filled degenerate pair = aromatic.

COMMON MISTAKE

Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

EXAM TIP

Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

MEMORY TRICK

'4n+2 happy, 4n flat unhappy'.

Why the Other Options Are Wrong

Correct answer: C

A **16**

Why (C) is the key — Pyrene has 16 π electrons, but its aromatic periphery carries 14 π: 4n + 2 = 14 → n = 3 (c).

B **4**

Ruled out: Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.

D **14**

Ruled out: Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

TOPIC REVISION

Aromaticity

4 PYQs · Last-minute revision

TOPIC SUMMARY

Hückel 4n+2 (aromatic), 4n planar (antiaromatic), non-planar/non-conjugated (non-aromatic); ions (cyclopropenyl$^+$, cyclopentadienyl$^-$, tropylium$^+$), heterocycles (furan, pyrrole, thiophene, pyridine), annulenes ([18] aromatic, [16] antiaromatic), azulene, Möbius aromaticity (4n), NMR ring-current test, Frost circle.

IMPORTANT FORMULA SHEET

- Aromatic: 2, 6, 10, 14, 18 π electrons
- Frost circle: polygon vertex down → orbital energies
- Ring current: outer H deshielded (δ 7–9), inner shielded (negative δ)

FREQUENTLY ASKED CONCEPTS

- Classify species as aromatic/anti/non
- Relative acidity of cyclopentadiene (pKa 16)
- Stability of tropylium
- Heterocycle aromaticity order (thiophene > pyrrole > furan)

COMMON MISTAKES & QUICK NOTES

Watch out:
Counting the exocyclic carbonyl π electrons (tropone) or both lone pairs of the heteroatom.
Cyclobutadiene is rectangular, not square — it avoids antiaromatic degeneracy.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q21 Q22 Q23 Q24

Expect 1 question(s) next session on Aromaticity.

TOPIC 5

General Organic Chemistry – General

12 questions · Easy 1 | Medium 9 | Hard 2 · PYQ frequency: Very High

Q25 **Consider the following statements about cis- and trans-decalins (A) cis-isomer is more stable than trans-isomer (B) trans-isomer is more stable than cis-isomer (C) trans-isomer undergoes ring-flip (D) cis-isomer undergoes ring-flip The correct statements among the above are**

A. B and D

B. A and C

C. A and D

D. B and C

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer A B and D

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- • Trans decalin is more stable than cis decalin by about 2.7kcal/mol. • The rigid conformation of trans decalin prohibits ring flipping. Else, it would result in highly strained system with one ring attached to other by two axial bond. • Cis decalin exists as an equilibrium between two enantiomeric chair conformation and flip into one other. Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (A).

FINAL: (A) B and D

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: A

B **A and C**

Why (A) is the key — • Trans decalin is more stable than cis decalin by about 2.7kcal/mol. • The rigid conformation of trans decalin prohibits ring flipping. Else, it would result in highly strained system with one ring attached to other by two axial bond. • Cis decalin exists as an equilibrium between two enantiomeric chair conformation and flip into one other. Explanation as extracted from the printed page; notation may be imperfect.

C **A and D**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D **B and C**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q26

The two benzylic hydrogens H_A and H_B in the compounds I and II, are (I) (II)

A. diastereotopic in I and enantiotopic in II

B. diastereotopic in II and enantiotopic in I

C. diastereotopic in both I and II

D. enantiotopic in both I and II

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer B diastereotopic in II and enantiotopic in I

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- In I (cis-2,6-dimethyl, meso) the benzylic CH_2 lies on the mirror plane, so H_A/H_B are enantiotopic. In II (trans, chiral) there is no such symmetry, so they are diastereotopic (b).
- Therefore the answer is (B).

FINAL: (B) diastereotopic in II and enantiotopic in I

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: B

A — **diastereotopic in I and enantiotopic in II**

Why (B) is the key — In I (cis-2,6-dimethyl, meso) the benzylic CH_2 lies on the mirror plane, so H_A/H_B are enantiotopic. In II (trans, chiral) there is no such symmetry, so they are diastereotopic (b).

C — **diastereotopic in both I and II**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D — **enantiotopic in both I and II**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q27

Methyl groups in the following compound are

A. Homotopic

B. Diasterotopic

C. Enantiotopic

D. Constitutionally heterotopic

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer A Homotopic

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- trans-4,5-Diphenyl-2,2-dimethyl-1,3-dioxolane has a C_2 axis through C-2 that swaps the two methyls, so they are homotopic (a).
- Therefore the answer is (A).

FINAL: (A) Homotopic

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: A

B **Diasterotopic**

Why (A) is the key — trans-4,5-Diphenyl-2,2-dimethyl-1,3-dioxolane has a C_2 axis through C-2 that swaps the two methyls, so they are homotopic (a).

C **Enantiotopic**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D **Constitutionally heterotopic**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q28

The number of geometrical isomers of the complex $[RhH(C \equiv CR)_2(PMe_3)_3]$

A) 2

B) 3

C) 4

D) 1

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer B 3

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- Octahedral MA_3B_2C (A = PMe_3, B = alkynyl, C = H): fac-A_3 (one isomer), mer-A_3 with the two alkynyls trans (one) or cis (one) — three geometrical isomers.
- Therefore the answer is (B).

FINAL: (B) 3

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: B

A — **2**

Why (B) is the key — Octahedral MA_3B_2C (A = PMe_3, B = alkynyl, C = H): fac-A_3 (one isomer), mer-A_3 with the two alkynyls trans (one) or cis (one) — three geometrical isomers.

C — **4**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D — **1**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q29

The correct order for the rate of thermal decarboxylation of the following compounds is
A B C

(A) C>B>A

(B) C > A > B

(C) A > C > B

(D) B>C>A

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer A C>B>A

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- 2-Pyridylacetic acid (C) decarboxylates most easily, through a cyclic zwitterion giving an enamine. Picolinic acid (B) loses CO_2 via the Hammick ylide. Benzoic acid (A) is very resistant. C > B > A (a).
- Therefore the answer is (A).

FINAL: (A) C>B>A

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: A

B **C > A > B**

Why (A) is the key — 2-Pyridylacetic acid (C) decarboxylates most easily, through a cyclic zwitterion giving an enamine. Picolinic acid (B) loses CO_2 via the Hammick ylide. Benzoic acid (A) is very resistant. C > B > A (a).

C **A > C > B**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D **B>C>A**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q30

In the most stable conformation of trans-1-t-butyl-3-methylcyclohexane, the substituents at C–1 and C–3, respectively, are

A. Axial and equatorial

B. Equatorial and equatorial

C. Equatorial and axial

D. Axial and axial

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer C Equatorial and axial

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- t-butyl group is a very bulky group. Bulky groups prefer equatorial position. Hence, t-butyl group is equatorial at C-1. Since the substituents are trans to each other, methyl group at C-3 prefers axial position. Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (C).

FINAL: (C) Equatorial and axial

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: C

A — **Axial and equatorial**

Why (C) is the key — t-butyl group is a very bulky group. Bulky groups prefer equatorial position. Hence, t-butyl group is equatorial at C-1. Since the substituents are trans to each other, methyl group at C-3 prefers axial position. Explanation as extracted from the printed page; notation may be imperfect.

B — **Equatorial and equatorial**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D — **Axial and axial**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q31

The relative rates of solvolysis of iodides A-C are

A. C > A > B

B. C>B>A

C. B > C > A

D. B > A > C

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer A C > A > B

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- The vinylic iodide B cannot ionise to a stabilised cation and is slowest. In the oxacyclooctyl iodide C the ring oxygen gives transannular (neighbouring-group) assistance, so C reacts faster than cyclooctyl iodide A: C > A > B (a).
- Therefore the answer is (A).

FINAL: (A) C > A > B

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: A

B — **C>B>A**

Why (A) is the key — The vinylic iodide B cannot ionise to a stabilised cation and is slowest. In the oxacyclooctyl iodide C the ring oxygen gives transannular (neighbouring-group) assistance, so C reacts faster than cyclooctyl iodide A: C > A > B (a).

C — **B > C > A**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D — **B > A > C**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q32

In the compound given below, the hydrogens marked A and B are

A. Homotopic

B. Isotopic

C. Enantiotopic

D. Diastereotopic

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer C Enantiotopic

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- cis-2,6-Diphenylpiperidin-4-one is meso, and the N–CH_2COOH carbon lies on its mirror plane. Replacing H_A or H_B gives enantiomers, so they are enantiotopic (c).
- Therefore the answer is (C).

FINAL: (C) Enantiotopic

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: C

A — **Homotopic**

Why (C) is the key — cis-2,6-Diphenylpiperidin-4-one is meso, and the N–CH_2COOH carbon lies on its mirror plane. Replacing H_A or H_B gives enantiomers, so they are enantiotopic (c).

B — **Isotopic**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D — **Diastereotopic**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q33

The correct order of magnitude of 'A values' for the given substituents in cyclohexane derivatives is X = CH_3, CN, Ph

A. Ph > CN > Me

B. Me>Ph>CN

C. CN > Me > Ph

D. Ph>Me>CN

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer D Ph>Me>CN

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- A values (kcal mol^{-1}): Ph 2.8 > Me 1.7 > CN 0.2 — the slim linear cyano group barely prefers equatorial.
- Therefore the answer is (D).

FINAL: (D) Ph>Me>CN

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: D

A **Ph > CN > Me**

Why (D) is the key — A values (kcal mol⁻¹): Ph 2.8 > Me 1.7 > CN 0.2 — the slim linear cyano group barely prefers equatorial.

B **Me>Ph>CN**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e⁻) as antiaromatic (it is non-aromatic).

C **CN > Me > Ph**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q34

The correct statements about conformations X and Y of 2-butanone are (X) (Y) (A) X is more stable than Y (B) Y is more stable than X (C) Methyl groups in X are anti (D) Methyl groups in Y are gauche

A. A and D

B. A and C

C. B and C

D. A, C and D

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer D A, C and D

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- Butanone prefers the conformer with the C-4 methyl eclipsing the C=O oxygen (X), where it is anti to the acyl CH_3. In Y the two methyls are gauche. A, C and D (d).
- Therefore the answer is (D).

FINAL: (D) A, C and D

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: D

A

A and D

Why (D) is the key — Butanone prefers the conformer with the C-4 methyl eclipsing the C=O oxygen (X), where it is anti to the acyl CH_3. In Y the two methyls are gauche. A, C and D (d).

B

A and C

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

C

B and C

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q35

For the following compounds, the correct order of reactivity towards nucleophilic acyl substitution is

A. acetyl chloride < methyl acetate < acetic anhydride < acetamide

B. acetamide < methyl acetate < acetic anhydride < acetyl chloride

C. acetamide < acetic anhydride < acetyl chloride < methyl acetate

D. methyl acetate < acetamide < acetic anhydride < acetyl chloride

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer B acetamide < methyl acetate < acetic anhydride < acetyl chloride

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- Leaving group ability affects the reactivity. The electropfhilic character of acetamide is minimum due to +R effect. +R effect is weaker in case of methyl acetate. +R effect is still weaker, acyl group is more electrophilic Weakest +R group, maximum electrophilicity of acyl group. Thus the order is acetamide < methyl acetate < acetic anhydride < acetyl chloride Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (B).

FINAL: (B) acetamide < methyl acetate < acetic anhydride < acetyl chloride

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: B

A **acetyl chloride < methyl acetate < acetic anhydride < acetamide**

Why (B) is the key — Leaving group ability affects the reactivity. The electropfhilic character of acetamide is minimum due to +R effect. +R effect is weaker in case of methyl acetate. +R effect is still weaker, acyl group is more electrophilic Weakest +R group, maximum electrophilicity of acyl group. Thus the order is acetamide < methyl acetate < acetic anhydride < acetyl chloride Explanation as extracted from the printed page; notation may be imperfect.

C **acetamide < acetic anhydride < acetyl chloride < methyl acetate**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D **methyl acetate < acetamide < acetic anhydride < acetyl chloride**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

Q36

In the following equilibrium, conformer B is more stable than A when R is A

(A) Me

(B) F

(C) Cl

(D) OMe

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
General Organic Chemistry – General

PYQ FREQUENCY
Very High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'4n+2 planar cyclic conjugated'.

Correct Answer B F

CONCEPT

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

LOGIC / WORKING

- For trans-1,4-disubstituted cyclohexanes small electronegative groups such as F favour the diaxial conformer B. Axial C–F bonds gain σ(C–H) → σ*(C–F) hyperconjugation and the dipoles cancel, whereas Me, Cl and OMe prefer diequatorial (b).
- Therefore the answer is (B).

FINAL: (B) F

SHORTCUT / EXAM TRICK

Aromaticity check: count π electrons in the ring only; lone pairs count only if in a p orbital needed for conjugation.

COMMON MISTAKE

Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

EXAM TIP

Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MEMORY TRICK

'4n+2 planar cyclic conjugated'.

Why the Other Options Are Wrong

Correct answer: B

A — **Me**

Why (B) is the key — For trans-1,4-disubstituted cyclohexanes small electronegative groups such as F favour the diaxial conformer B. Axial C–F bonds gain σ(C–H) → σ*(C–F) hyperconjugation and the dipoles cancel, whereas Me, Cl and OMe prefer diequatorial (b).

C — **Cl**

Ruled out: Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).

D — **OMe**

Ruled out: Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

TOPIC REVISION

General Organic Chemistry – General

12 PYQs · Last-minute revision

TOPIC SUMMARY

Electronic effects (inductive, resonance, hyperconjugation), acidity/basicity trends, aromaticity (Hückel 4n+2, antiaromatic, homoaromatic), nomenclature of polycyclics/spiro/bridged, conformational analysis (A-values, anomeric effect), reactive intermediates (carbocation stability, carbenes, nitrenes), stereochemistry descriptors (R/S, E/Z, pro-R/pro-S).

IMPORTANT FORMULA SHEET

- Hückel: planar, cyclic, conjugated, 4n+2 π electrons
- A-values: t-Bu 4.9 > Ph 2.8 > iPr 2.2 > Me 1.7 kcal/mol
- Carbocation: 3° > 2° > 1° ; benzylic/allylic ≈ 2°–3°
- pKa: acetic 4.8, phenol 10, alcohol 16, alkyne 25, alkene 44, alkane 50

FREQUENTLY ASKED CONCEPTS

- Rank acidity/basicity with effects
- Aromatic/antiaromatic/non-aromatic classification
- Most stable conformer of substituted cyclohexanes
- IUPAC names of bicyclics (von Baeyer)
- R/S assignment with priorities

COMMON MISTAKES & QUICK NOTES

Watch out:
Counting both lone pairs of a ring oxygen; treating cyclooctatetraene (tub, 8 e^-) as antiaromatic (it is non-aromatic).
Anomeric effect: electronegative substituents at C1 of pyranoses prefer axial.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33 Q34 Q35 Q36

Expect 2 question(s) next session on General Organic Chemistry – General.

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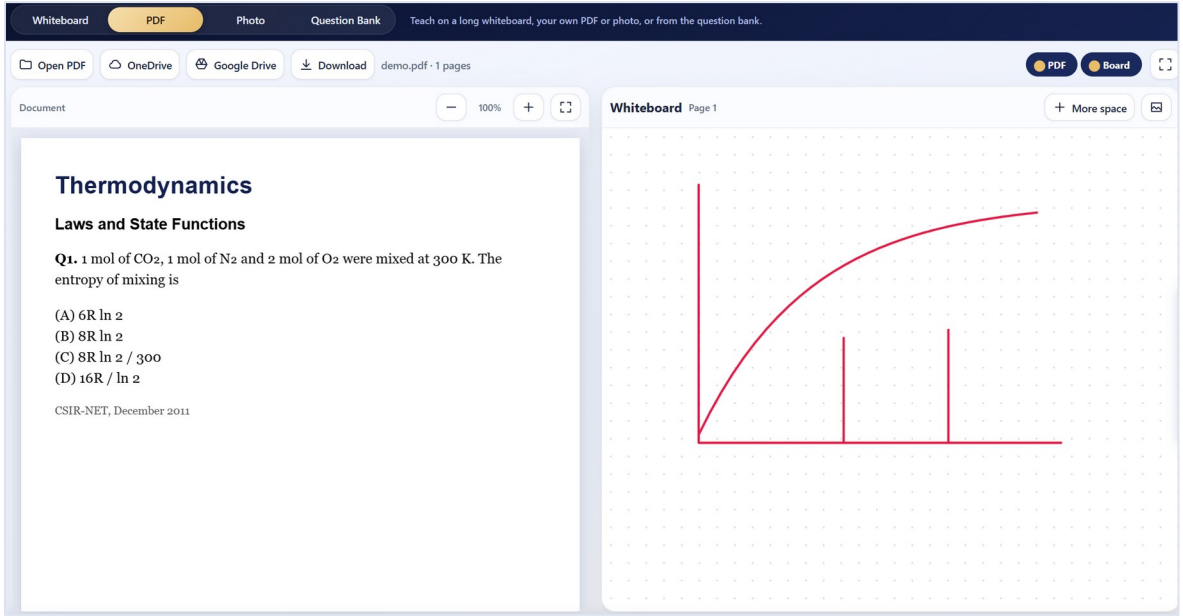
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