# Organic Chemistry Practice Exam B

**INSTRUCTOR ANSWER KEY — COMPLETE EXPLANATIONS**

**Directions:** Answers are in red. Key includes a concise rationale for each item.

1. **2-Bromobutane is heated with sodium ethoxide in ethanol. Which pathway is generally favored?**

   A. SN1

   B. SN2

   C. E1

   **D. E2**

   **Reasoning:** A secondary substrate with a strong base under heated conditions generally favors concerted E2; substitution may compete.

2. **Iodomethane and NaCN in DMSO: expected mechanism?**

   A. SN1

   B. E1

   **C. SN2**

   D. E2

   **Reasoning:** Methyl substrates cannot form stable free carbocations and have no beta carbon; cyanide attacks by SN2.

3. **An SN2 reaction follows which idealized rate law?**

   A. rate = k[RX]

   B. rate = k[Nu]

   **C. rate = k[RX][Nu]**

   D. rate = $k[RX]^2$

   **Reasoning:** Both substrate and nucleophile participate in the rate-limiting bimolecular step.

4. **At a stereogenic carbon, an SN2 reaction normally produces which geometric outcome?**

   A. Retention

   **B. Inversion**

   C. Complete racemization

   D. No stereochemical change

   **Reasoning:** Backside attack causes inversion of the tetrahedral arrangement; the R/S label may or may not change if priorities differ.

5. **Two highest-priority groups on an alkene are on opposite sides. It is:**

   **A. E**

   B. Z

   C. R

   D. S

**Reasoning:** E (entgegen) denotes opposite sides for the highest-priority substituents.

**6. What does a racemic sample contain?**

A. One enantiomer only

**B. Equal amounts of both enantiomers**

C. Two constitutional isomers

D. Only achiral compounds

**Reasoning:** A racemate is an equal mixture of a pair of enantiomers and is optically inactive as a mixture.

**7. Which statement about stereochemical labels in SN2 is most accurate?**

A. R always becomes S

B. S always becomes R

**C. The geometry inverts, but the R/S label depends on CIP priorities**

D. SN2 is always racemic

**Reasoning:** Mechanistic inversion is a geometric fact; a substitution may alter CIP rank, so absolute labels need reassessment.

**8. A carboxylic acid O–H stretch is often characterized by:**

A. Sharp peak at 2250 cm−1

**B. Very broad absorption about 2500–3300 cm−1**

C. Single sharp peak at 1600 cm−1

D. No IR absorption

**Reasoning:** Carboxylic acids frequently exhibit a very broad O–H envelope overlapping C–H stretching.

**9. An aromatic proton often resonates in approximately which $^{1}$H NMR region?**

A. 0–1 ppm

**B. 6.5–8.5 ppm**

C. 12–16 ppm

D. 18–20 ppm

**Reasoning:** Many aromatic C–H signals lie around 6.5–8.5 ppm, depending on substituents.

**10. A TLC spot travels 2.4 cm while the solvent front travels 6.0 cm. Rf = ?**

A. 0.25

**B. 0.40**

C. 2.5

D. 3.6

**Reasoning:** Rf = spot travel / solvent-front travel = 2.4 / 6.0 = 0.40.

**11. Which reagent converts propanone into propan-2-ol?**

**A. NaBH4, then workup**

B. PCC

C. $KMnO_4$, hot

D. $Br_2/h\nu$

**Reasoning:** $NaBH_4$ reduces a ketone to the corresponding secondary alcohol.

**12. Cyclohexene can be converted to cyclohexanol with:**

**A. Aqueous acid-catalyzed hydration**

B. PCC

C. $NaNH_2/NH_3$

D. NaI/acetone

**Reasoning:** Acid-catalyzed hydration adds H and OH across the alkene.

**13. 2-Butyne treated with $H_2$ and Lindlar catalyst yields predominantly:**

A. trans-2-butene

**B. cis-2-butene**

C. Butane

D. 2-butanol

**Reasoning:** Lindlar catalyst partially hydrogenates alkynes by syn addition, producing a cis alkene.

**14. $NaBH_4$ followed by aqueous workup reduces a simple ketone to:**

A. A primary alcohol

**B. A secondary alcohol**

C. An ester

D. An alkene

**Reasoning:** The carbonyl carbon of a ketone becomes the carbon bearing OH and two alkyl groups.

**15. Strong aqueous chromium(VI) oxidation of a primary alcohol commonly yields:**

A. An aldehyde only

**B. A carboxylic acid**

C. A tertiary alcohol

D. An ether

**Reasoning:** Strong aqueous oxidants typically oxidize primary alcohols past the aldehyde to the acid.

**16. Formaldehyde + Grignard reagent, then workup, gives:**

**A. A primary alcohol**

B. A secondary alcohol

C. A tertiary alcohol

D. An ester

**Reasoning:** Addition to $H_2C{=}O$ generates $RCH_2OH$ after protonation: a primary alcohol.

**17. Under acidic aqueous hydrolysis, a typical amide can ultimately produce:**

**A. Carboxylic acid and protonated amine/ammonium species**

**B.** Alkene and hydrogen

**C.** Ester and HCl

**D.** Epoxide and ether

**Reasoning:** Acid-catalyzed amide hydrolysis produces a carboxylic acid and protonated nitrogen-containing product.

**18. Which is a Lewis base?**

**A. Electron-pair donor**

**B.** Electron-pair acceptor

**C.** Only a proton donor

**D.** A compound with no electrons

**Reasoning:** A Lewis base donates an electron pair to form a bond.

**19. Which reagent is typically a strong nucleophile but relatively weak base?**

**A. $N_3^-$**

**B.** tert-Butoxide

**C.** $H_2O$

**D.** tert-Butanol

**Reasoning:** Azide is an effective nucleophile, yet relatively weak base, making substitution competitive.

**20. Which geometric condition is associated with a typical alkene π bond?**

**A. Restricted rotation about C=C**

**B.** Free rotation about C=C at room temperature

**C.** No p orbitals

**D.** Carbon bonded to six atoms

**Reasoning:** The π bond arises from p-orbital overlap, so rotation about a double bond is restricted.