MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which of the following best describes the carbon–chlorine bond of an alkyl chloride?
   A) nonpolar; no dipole
   B) polar; d+ at carbon and d- at chlorine
   C) polar; d- at carbon and d+ at chlorine
   D) ionic
   E) none of the above

2) Which of the following is classified as a vinylic halide?
   A) CH₃CH=CHOH
   B) CH₃CH=CHCl
   C) CH₃CH=CHCH₂Cl
   D) CH₃CH₂CH₂CH₂Br
   E) BrCH₂CH=CH₂

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

3) Provide an acceptable name for CHCl₃.

4) Provide an acceptable name for the compound shown below.

![Compound Image]

5) Provide an acceptable name for CH₃CH₂CH₂C(CH₃)₂I.

6) Provide an acceptable name for the compound shown below.

![Compound Image]

7) Provide the structure of isopropyl iodide.

8) Provide the structure of 1-bromo-3-methylhexane.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

9) Which of the following is a geminal dihalide?
   A) cis-1,2-dibromocyclopentane
   B) 3,3-dichloropentane
   C) trans-1,4-diiodocyclohexane
   D) isobutyl chloride
   E) 1,3-dibromoheptane

10) Which of the following is a vicinal dihalide?
    A) cis-1,2-dibromocyclopentane
    B) 3,3-dichloropentane
    C) trans-1,4-diiodocyclohexane
    D) isobutyl chloride
    E) 1,3-dibromoheptane

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

11) The term CFC is an abbreviation for __________.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

12) Which of the following best describes DDT?
    A) a chlorocarbon used to decaffeinate coffee beans
    B) a polybrominated organic compound used as a herbicide
    C) a Freon used as a foaming agent
    D) a mixed alkyl halide used as an anesthetic
    E) a polychlorinated organic compound used as an insecticide

13) Which of the following is a secondary alkyl halide?
    A) methyl bromide
    B) isopropyl chloride
    C) t-butyl iodide
    D) propyl bromide
    E) isobutyl chloride

14) Which of the following is a primary alkyl halide?
    A) methyl bromide
    B) isopropyl bromide
    C) t-butyl iodide
    D) cyclohexyl bromide
    E) isobutyl chloride

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

15) Although F is more electronegative than Cl, the C–Cl bond has a larger dipole moment than the C–F bond. Explain.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) Among the following alkyl halides, choose the one with the lowest boiling point.
   A) t-butyl chloride
   B) n-butyl chloride
   C) t-butyl bromide
   D) n-butyl iodide
   E) t-butyl iodide

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

17) When water is shaken with dichloromethane, a two-phase system results. Which compound forms the upper phase? Explain.

18) Provide the structure of the major organic product in the reaction below.

19) Provide the structure of the major organic product in the reaction below.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

20) Which of the following species is the least nucleophilic?
   A) H2O
   B) BF3
   C) (CH3)3N
   D) CH3O-
   E) CN-

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

21) Provide a detailed, stepwise mechanism for the reaction below.

\[
(CH3)2CHCH2CH2CH2I + CN^- \rightarrow (CH3)2CHCH2CH2CH2CH2CN + I^-
\]

22) Do all primary alkyl iodides undergo S_N2 reactions with sodium cyanide in DMSO at identical rates? Explain.

23) Rank the species below in order of increasing nucleophilicity in hydroxylic solvents:
   CH3CO2-, CH3S-, HO-, H2O.

24) What type of solvent is best for S_N2 reactions which employ anionic nucleophiles: polar, protic solvents; polar, aprotic solvents; or nonpolar solvents? Explain.

25) Provide the structure of the major organic product which results when (S)-2-iodopentane is treated with KCN in DMF.
26) Consider the reaction of (CH₃)₃CO⁻ with iodomethane. Will the reaction rate increase, decrease, or remain the same if the concentration of iodomethane is increased? Explain.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

27) Which of the following compounds will undergo an Sₕ₂ reaction most readily?  
A) (CH₃)₃CCH₂I  
B) (CH₃)₃CCl  
C) (CH₃)₂CHI  
D) (CH₃)₂CHCH₂CH₂CH₂I  
E) (CH₃)₂CHCH₂CH₂CH₂Cl

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

28) Provide the structure of the major organic product in the following reaction.

29) Provide the structure of the major organic product in the following reaction.

(CH₃)₃N + CH₃CH₂CH₂I →

30) Which of the following alkyl chlorides would undergo substitution most rapidly when treated with Na C≡CH chloroethane, 2-chloropropane, or 1-chloro-2,2-dimethylpropane? Provide the structure of the substitution product.

31) Provide the major organic product of the reaction below and a detailed, stepwise mechanism which accounts for its formation.

32) When t-butyl chloride undergoes solvolysis in a solvent mixture composed of 70% water/30% acetone, the reaction rate is slower than when the same compound is solvolyzed in 80% water/20% acetone. Explain.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

33) When ionization occurs at the single stereocenter of a chiral compound, the resulting carbocation is:  
A) achiral  
B) chiral  
C) racemic  
D) optically active  
E) none of the above
34) SN1 reactions usually proceed with:
   A) equal amounts of inversion and retention at the center undergoing substitution.
   B) slightly more inversion than retention at the center undergoing substitution.
   C) slightly more retention than inversion at the center undergoing substitution.
   D) complete inversion at the center undergoing substitution.
   E) complete retention at the center undergoing substitution.

35) Which of the compounds below undergoes solvolysis in aqueous ethanol most rapidly?
   A) cyclohexyl bromide
   B) methyl iodide
   C) isopropyl chloride
   D) 3-chloropentane
   E) 3-ido-3-methylpentane

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

36) Provide two circumstances under which solvolysis of a chiral alkyl halide would not result in the generation of a mixture of enantiomeric products.

37) Provide a series of synthetic steps by which (CH₃)₂C=CH₂ could be prepared from 2-methylpropane.

38) Why does CH₂=CHCHBrCH₃ undergo solvolysis much more rapidly than 2-bromobutane?

39) When 1-bromo-2, 2-dimethylcyclopentane is heated in ethanol, one of the products which results is shown below. Provide a detailed, stepwise mechanism for the production of this compound, and give the name of the mechanism by which it is produced.

40) Provide the structure of the major organic products which result in the reaction below.

41) Provide the structure of the major organic product which results in the following reaction.
42) Provide the structure of the major organic product which results in the following reaction.

```
CH₃
/ \ 
H   D  Br
```

43) Provide the structure of the major organic product which results in the following reaction.

```
CH₃
/ \ 
D   H  Br
```

44) Provide the structure of the major organic product which results in the following reaction.

```
CH₃
/ \ 
H   D  Br
```

45) Which diastereomer of 1-bromo-4-t-butylcyclohexane, the cis or the trans, undergoes elimination more rapidly when treated with sodium ethoxide? Explain your answer.

46) List the following compounds in order of increasing reactivity in an Sₐ1 reaction.

CH₃Br, CH₃CH₂CH₂I, (CH₃)₃Cl, CH₃CHBrCH₃, CH₃CHICH₃

47) Provide the structure of the major organic product which results in the following reaction.

```
CH₃
\ / 
/ D-
\ H
```

48) When 1-iodo-1-methylcyclohexane is treated with NaOCH₂CH₃, the more highly substituted alkene product predominates. When KOCH(CH₃)₃ is used instead, the less highly substituted alkene product predominates. Offer an explanation.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

49) Which of the following statements correctly describe(s) E1 reactions of alkyl halides (RX)?

I. Rate = k[base]
II. Rate = k[base][RX]
III. Rate = k[RX]
IV. The reactions occur in two or more distinct steps.
V. Rearrangements are sometimes seen.

A) II and IV
B) III and V
C) I, IV, and V
D) I only
E) III, IV, and V

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

50) What is Zaitsev’s rule?

51) Provide the structure of the major organic product which results when 2-bromo-2-methylbutane is treated with sodium ethoxide.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

52) How many distinct alkene products are possible when the alkyl iodide below undergoes E2 elimination?

\[\text{CH}_3\text{CHI}\]

A) 1
B) 2
C) 3
D) 4
E) 5

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

53) Provide the structure of the major organic product in the following reaction.

\[\text{CH}_3\text{CH} = \text{CHCH}_3 + \text{H}^+ \rightarrow \text{CH}_3\text{C} = \text{CHCH}_3\]

54) Provide the structure of the major organic product in the following reaction.

\[\text{CH}_3\text{CBr(Ph)} + \text{NaOCH}_3 \rightarrow \text{CH}_3\text{CBr(Ph)} + \text{H}_2\text{O}\]

55) Show the best way to prepare \(\text{CH}_3\text{OCH(CH}_3\text{)}_2\) by an \(\text{SN}_2\) reaction.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

56) Predict the most likely mechanism for the reaction shown below.

\[
\begin{array}{c}
\text{CH}_3 \quad \text{Cl} \\
\text{H}_2\text{O} \\
\Delta \\
\text{A) SN1} \quad \text{B) SN2} \quad \text{C) E1} \quad \text{D) E2} \quad \text{E) E1cb}
\end{array}
\]

57) Predict the most likely mechanism for the reaction shown below.

\[
\begin{array}{c}
\text{CH}_3 \\
\text{C} \quad \text{H}_3 \\
\text{NaOCH}_3 \\
\text{CH}_3\text{OH} \\
\text{A) SN1} \quad \text{B) SN2} \quad \text{C) E1} \quad \text{D) E2} \quad \text{E) E1cb}
\end{array}
\]

58) Predict the two most likely mechanisms for the reaction of 2-iodohexane with sodium ethoxide.

\[
\begin{array}{c}
\text{A) SN2 and SN1} \\
\text{B) E1 and E2} \\
\text{C) SN2 and E2} \\
\text{D) E1 and SN1} \\
\text{E) E2 and SN1}
\end{array}
\]

59) Predict the two most likely mechanisms which occur when 2-iodohexane is heated in ethanol.

\[
\begin{array}{c}
\text{A) SN2 and SN1} \\
\text{B) E1 and E2} \\
\text{C) SN2 and E2} \\
\text{D) E1 and SN1} \\
\text{E) E2 and SN1}
\end{array}
\]

60) Which of the following alkyl halides is most likely to undergo rearrangement in an SN1 reaction?

\[
\begin{array}{c}
\text{A) 3-bromopentane} \\
\text{B) 2-chloro-3,3-dimethylpentane} \\
\text{C) 3-chloropentane} \\
\text{D) bromocyclohexane} \\
\text{E) 1-bromo-4-methylcyclohexane}
\end{array}
\]

61) Which of the following alkyl chlorides will undergo SN2 reaction most readily?

\[
\begin{array}{c}
\text{A) 1-chloro-4-methylpentane} \\
\text{B) 2-chloro-4-methylpentane} \\
\text{C) 2-chloro-3-methylpentane} \\
\text{D) 3-chloro-2-methylpentane} \\
\text{E) 2-chloro-2-methylpentane}
\end{array}
\]
62) Which of the following compounds is the most nucleophilic?
A) CH₃SH
B) CH₃OH
C) H₂O
D) CH₃CO₂H
E) BF₃

63) Which of the following solvents could be described as polar and protic?
A) ethanol
B) acetonitrile
C) dimethylformamide
D) acetone
E) 18-crown-6

64) The major product from the reaction of 2-chloro-2-methylpentane with sodium ethoxide in ethanol results from which of the following mechanistic pathways?
A) S_N1
B) S_N2
C) E1
D) E2
E) E1cb

65) The major product which results when 2-chloro-2-methylpentane is heated in ethanol is an ether. From which mechanistic pathway does this ether arise?
A) S_N1
B) S_N2
C) E1
D) E2
E) E1cb

66) Which of the following mechanisms (S_N1, S_N2, E1, E2) feature(s) a carbocation intermediate?
A) S_N1 only
B) S_N2 only
C) E1 only
D) E2 only
E) both S_N1 and E1

67) In which of the following mechanisms (S_N1, S_N2, E1, E2) are alkenes the major reaction products?
A) S_N1 only
B) S_N2 only
C) E1 only
D) E2 only
E) both E1 and E2

68) Which of the following alkyl bromides undergoes solvolysis in aqueous methanol most rapidly?
A) PhCHBrCH₃
B) (CH₃)₂CHCH₂CH₂Br
C) (CH₃)₂CHCH₂CHBrCH₃
D) CH₃CH₂CH₂CH₂Br
E) PhBr
69) Which of the following alkyl chlorides is least likely to undergo rearrangement during a solvolysis reaction?
   A) 2-chloro-4-methylpentane
   B) 2-chloro-3-methylpentane
   C) 2-chloro-2-methylpentane
   D) cis-1-chloro-2-ethylcyclohexane
   E) trans-1-chloro-2-ethylcyclohexane

70) Which of the following alkyl halides can produce only a single alkene product from when treated with sodium methoxide?
   A) 2-chloro-2-methylpentane
   B) 3-chloro-3-ethylpentane
   C) 3-chloro-2-methylpentane
   D) 2-chloro-4-methylpentane
   E) 2-chloro-3-ethylpentane

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

71) Provide the name of the bromoalkane shown below.

72) Which of the following alkyl halides has the smallest molecular dipole moment?
   A) CH₃F
   B) CH₃Cl
   C) CH₂I₂
   D) CH₂Cl₂
   E) CF₄

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

73) Arrange the following alkyl halides in order of increasing boiling point:
   CH₃CH₂Br, CH₃CH₂CH₂Br, (CH₃)₂CHBr, CH₃CH₂F.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

74) When 2,2-dimethylbutane is subjected to free-radical chlorination, _________ distinct monochlorinated products are possible and _________ of these contain asymmetric carbon atoms.
   A) 4, 2
   B) 5, 0
   C) 3, 0
   D) 5, 2
   E) 4, 0

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

75) Provide the structure of the major organic product that results when the reagents below are combined, and name the mechanism through which this reaction is proceeding.

CH₃C≡C⁻Na⁺ + CH₃CH₂CH₂I
76) Arrange the following species in order of increasing nucleophilicity: 
CH₃CH₂S⁻, CH₃CH₂O⁻, (CH₃)₃CO⁻, (CH₃)₃COH.

77) Arrange the following substrates in order of their increasing SN2 reactivity with NaCN: 
bromoethane, 1-chloro-3,3-dimethylpentane, 1-chloro-2,2-dimethylpentane, and 2-bromo-2-methylpentane.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

78) When 3-iodo-3-ethylpentane is treated with sodium methoxide in methanol, the major organic product is an _______ that is generated through an _______ mechanism.
   A) ether, S_N1  B) ether, S_N2  C) ether, E1  D) alkene, E2  E) alkene, E1

79) Provide the structure of the major alkene product of the reaction below.

80) Arrange the following compounds in order of increasing reactivity toward ethanol solvolysis: 
t-butyl bromide, t-butyl iodide, isopropyl chloride, methyl iodide.

81) List the following bromides in order of their increasing reactivity as substrates in S_N2 reactions: PhBr, PhCH₂Br, and PhCH(CH₃)Br.

82) List the following bromides in order of their increasing reactivity as substrates in S_N1 reactions: PhBr, PhCH₂Br, and PhCH(CH₃)Br.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

83) When 3-iodo-3-ethylpentane is heated in methanol, the major organic product is an _______ that is generated through an _______ mechanism.
   A) ether, S_N1  B) ether, S_N2  C) ether, E1  D) alkene, E2  E) alcohol, E1

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

84) Which halide is a better nucleophile, iodide or fluoride? Explain.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

85) What type of intermediate is present in the S_N2 reaction of cyanide with bromoethane?  
   A) carbocation  
   B) free radical  
   C) carbene  
   D) carbanion  
   E) This reaction has no intermediate.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

86) List the following bromides in order of their increasing reactivity as substrates in S_N2 reactions: 2-chlorobutane, 2-iodobutane, and 1-iodobutane.

87) List the following bromides in order of their increasing reactivity as substrates in S_N1 reactions: 2-chlorobutane, 2-iodobutane, and 1-iodobutane.

88) Which is more nucleophilic, t-butoxide or ethoxide? Explain.

89) Do all primary iodides react with N_3^- at the same rate via the S_N2 mechanism? Explain.

90) List the following bromides in order of their increasing reactivity as substrates in S_N1 reactions: 1-iodo-1-ethylcyclopentane, chlorocyclopentane, and iodocyclopentane.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

91) What is the IUPAC name of the compound shown below?

A) (1S,3S)-1,3-dichloro-1-ethyl-3-methylcyclopentane  
B) (1R,3S)-1,3-dichloro-1-methyl-3-ethylcyclopentane  
C) (1R,4S)-1,4-dichloro-1-ethyl-4-methylcyclopentane  
D) (1R,3S)-1,3-dichloro-1-ethyl-3-methylcyclopentane  
E) (1S,3R)-1,3-dichloro-3-ethyl-1-methylcyclopentane
92) What is the IUPAC of the compound shown below?

A) (2R,3S,4S)-2-chloro-3,4-dibromo-3-methylhexane
B) (2R,3S,4S)-3,4-dibromo-2-chloro-3-methylhexane
C) (3S,4S,5S)-3,4-dibromo-5-chloro-4-methylhexane
D) (2R,3R,4S)-3,4-dibromo-2-chloro-3-methylhexane
E) (2R,3S,4R)-3,4-dibromo-2-chloro-3-methylhexane

93) Draw two reasonable resonance structures and the hybrid of the intermediate formed in the following reaction.

94) Draw the structures of the two major products formed in the following reaction. Indicate which of the two structures would be predicted to predominate under thermodynamic condition and explain why.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

95) When (cis)-1-bromo-2-methylcyclohexane is treated with methanol and heat, four different products are formed – two by substitution and two by elimination.

Which of the following conditions would change the outcome of this reaction by promoting the production of 3-methylhexene as the major product?

A) KOH, ethanol and heat
B) water/acetone and heat
C) tert-butoxide/tert-butyl alcohol
D) tert-butyl alcohol and heat
E) methoxide/methanol

96) A sample of 1-chloro-1-phenylethane with an $\alpha^{25}_D$ of −94.8° is reacted with NH$_3$ in methanol/water solvent. The major substitution product of the reaction is 1-phenyl-1-ethylamine with an $\alpha^{25}_D$ of −8.6°. Given that optically pure (R) 1-chloro-1-phenylethane has a specific rotation of −109.0° and that optically pure (R) 1-phenyl-1-ethylamine has a specific rotation of +39.3°, which of the following statements best describes this reaction?

A) Net inversion 25% with 75% racemization -- $S_N1$ mechanism
B) Net inversion 12% with 88% racemization -- $S_N1$ mechanism
C) Net inversion 75% with 25% racemization -- $S_N2$ mechanism
D) Net inversion 12% with 88% racemization -- $S_N2$ mechanism
E) Net inversion 88% with 12% racemization -- $S_N2$ mechanism
97) Dehydration of 1-butanol with concentrated sulfuric acid at 140°C results in the formation of mainly trans-2-butene. According to these results, which of the following conclusions might be valid?

A) The reaction undergoes an E2-type elimination mechanism
B) The reaction follows a new mechanism involving the formation of a carbanion intermediate
C) The reaction undergoes an E1-type elimination mechanism in conjunction with a hydride shift
D) The reaction undergoes an E2-type elimination mechanism in conjunction with a methyl shift
E) The reaction undergoes an E1-type elimination mechanism with no shifting

98) Rank the following molecules in order of increasing relative rate of SN1 solvolysis with methanol and heat (slowest to fastest reacting).

A) 3 < 2 < 4 < 5 < 1
B) 2 < 3 < 4 < 1 < 5
C) 5 < 4 < 3 < 2 < 1
D) 2 < 3 < 4 < 5 < 1
E) 1 < 2 < 5 < 4 < 3
Answer Key
Testname: QOI0809SN

1) B
   ID: oc6w 6-1
   Diff: 1
   Skill:

2) B
   ID: oc6w 6-2
   Diff: 1
   Skill:

3) chloroform or trichloromethane
   ID: oc6w 6-3
   Diff: 1
   Skill:

4) 4-bromo-1,1-dimethylcyclohexane
   ID: oc6w 6-4
   Diff: 2
   Skill:

5) 2-iodo-2-methylpentane
   ID: oc6w 6-5
   Diff: 1
   Skill:

6) cis-1, 2-dichlorocyclopentane
   ID: oc6w 6-6
   Diff: 1
   Skill:

7) (CH₃)₂CHI
   ID: oc6w 6-7
   Diff: 1
   Skill:

8) CH₃CH₂CH₂CH(CH₃)CH₂CH₂Br
   ID: oc6w 6-8
   Diff: 2
   Skill:

9) B
   ID: oc6w 6-9
   Diff: 2
   Skill:

10) A
    ID: oc6w 6-10
    Diff: 2
    Skill:

11) chlorofluorocarbon
    ID: oc6w 6-11
    Diff: 1
    Skill:

12) E
    ID: oc6w 6-12
    Diff: 2
    Skill:
13) B
   ID: oc6w 6-13
   Diff: 2
   Skill:

14) E
   ID: oc6w 6-14
   Diff: 2
   Skill:

15) The bond dipole moment is determined by a product of the amount of charge separation and the distance over which the charge is separated, \( \mu = 4.8 \times \delta \times d \). Although \( \delta \) is larger in the C–F bond, the greater length of the C–Cl bond ultimately makes its dipole moment larger.
   ID: oc6w 6-15
   Diff: 3
   Skill:

16) A
   ID: oc6w 6-16
   Diff: 2
   Skill:

17) Water is less dense than dichloromethane and therefore forms the upper phase.
   ID: oc6w 6-17
   Diff: 2
   Skill:

18)
   \[
   \begin{array}{c}
   \text{Br} \\
   \text{CHCH}_2\text{CH}_3
   \end{array}
   \]
   ID: oc6w 6-18
   Diff: 2
   Skill:

19)
   \[
   \begin{array}{c}
   \text{Br}
   \end{array}
   \]
   ID: oc6w 6-19
   Diff: 2
   Skill:

20) B
    ID: oc6w 6-20
    Diff: 2
    Skill:

21)
   \[
   \begin{array}{c}
   (\text{CH}_3)_2\text{CHCH}_2\text{CH}_2 + \text{CN}^- \rightarrow (\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{CN}^+ \text{I}^-
   \end{array}
   \]
   ID: oc6w 6-21
   Diff: 2
   Skill:
22) No. All primary iodides are not equally accessible to attack by the CN\(^-\). Steric hindrance varies among primary iodides.
   ID: oc6w 6–22
   Diff: 2
   Skill:

23) H\(_2\)O \(<\) CH\(_3\)CO\(_2\)\(^-\) \(<\) HO\(^-\) \(<\) CH\(_3\)S\(^-\)
   ID: oc6w 6–23
   Diff: 2
   Skill:

24) Polar, aprotic solvents are best. These solvents have strong dipole moments to enhance solubility of the anionic species but lack the ability to solvate the anion by hydrogen bonding.
   ID: oc6w 6–24
   Diff: 3
   Skill:

25) ![ Chemical structure for problem 25 ]
   ID: oc6w 6–25
   Diff: 2
   Skill:

26) This is an SN2 reaction with a rate = k[(CH\(_3\))\(_3\)CO\(^-\)] [CH\(_3\)I]. The reaction rate will increase as [CH\(_3\)I] increases.
   ID: oc6w 6–26
   Diff: 1
   Skill:

27) D
   ID: oc6w 6–27
   Diff: 2
   Skill:

28) ![ Chemical structure for problem 28 ]
   ID: oc6w 6–28
   Diff: 2
   Skill:

29) [(CH\(_3\))\(_3\)NCH\(_2\)CH\(_2\)CH\(_3\)]\(^+\) I\(^-\)
   ID: oc6w 6–29
   Diff: 2
   Skill:

30) CH\(_3\)CH\(_2\)C≡CH
   ID: oc6w 6–30
   Diff: 2
   Skill:
31) This is purely a solvent effect. The greater the percentage of water in this solvent mixture, the more polar the solvent. The more polar the solvent, the more easily solvated the developing carbocation and the more rapidly it is formed.

32) A

33) B

34) E

35) Choose from among:
   (i) leaving group not bound to stereocenter
   (ii) rearrangement yields a carbocation in which two groups bound to the cationic center are the same
   (iii) the molecule contains at least one additional stereocenter which is unaffected by the ionization
   (iv) rearrangement ultimately results in a meso compound
37) 1. Br₂, hv
2. NaOCH₃, CH₃OH
   
   ID: oc6w 6–37
   Diff: 2
   Skill:

38) The intermediate carbocation is resonance stabilized.
   
   ID: oc6w 6–38
   Diff: 3
   Skill:

39) 

```
  \[ \text{Br} \quad \Delta \quad \text{CH₃} \quad \text{CH₃} \]
  \[ \text{CH₃} \quad \text{CH₃} \quad \text{CH₃} \]

  \[ \text{CH₃} \quad \text{CH₃} \quad \text{CH₃} \]
```

E1 mechanism

ID: oc6w 6–39
Diff: 3
Skill:

40)

```
  \[ \text{CH₃} \quad \text{OCH₂CH₃} \quad \text{CH₃} \quad \text{OCH₂CH₃} \]
```

ID: oc6w 6–40
Diff: 2
Skill:

41)

```
  \[ \text{CH₃} \quad \text{CH₃} \quad \text{CH₃} \quad \text{HO} \quad \text{CH₃} \]
```

ID: oc6w 6–41
Diff: 3
Skill:

42)

```
  \[ \text{CH₃} \quad \text{CH₃} \]
```

ID: oc6w 6–42
Diff: 3
Skill:
43) The cis isomer reacts more quickly. An axial orientation of the C–Br bond is required for E2 in six-membered ring systems. In order for this to occur in the trans isomer, the bulky t-buty1 group must also assume an axial orientation; this requires substantial energy of activation.

44) \[
\begin{align*}
\text{CH}_3\text{Br} & < \text{CH}_3\text{CH}_2\text{I} \\
\text{CH}_3\text{CHBrCH}_3 & < \text{CH}_3\text{CHICH}_3 < (\text{CH}_3)_3\text{Cl}
\end{align*}
\]

45) The unhindered ethoxide procedures the more stable alkene product (ie, the more highly substituted alkene possible) when the bulky t-butoxide is used, the most accessible hydrogen is removed. This results in the least highly substituted alkene possible.

46) In elimination reactions, the most highly substituted alkene product is the major product.
Answer Key
Testname: QOI0809SN

51) 

\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
& \quad \text{CH}_3 \\
& \quad \text{CH}_3
\end{align*}
\]

ID: oc6w 6-51
Diff: 2
Skill:

52) E

ID: oc6w 6-52
Diff: 2
Skill:

53) 

\[
\begin{align*}
\text{Ph} & \quad \text{H} \\
& \quad \text{Ph}
\end{align*}
\]

ID: oc6w 6-53
Diff: 3
Skill:

54) 

\[
\begin{align*}
\text{Ph} & \quad \text{H} \\
& \quad \text{Ph}
\end{align*}
\]

ID: oc6w 6-54
Diff: 3
Skill:

55) CH₃I + NaOCH(CH₃)₂

ID: oc6w 6-55
Diff: 2
Skill:

56) A

ID: oc6w 6-56
Diff: 2
Skill:

57) D

ID: oc6w 6-57
Diff: 2
Skill:

58) C

ID: oc6w 6-58
Diff: 2
Skill:

59) D

ID: oc6w 6-59
Diff: 2
Skill:

60) B

ID: oc6w 6-60
Diff: 2
Skill:
Answer Key
Testname: QOI0809SN

61) A
   ID: oc6w 6-61
   Diff: 2
   Skill:

62) A
   ID: oc6w 6-62
   Diff: 2
   Skill:

63) A
   ID: oc6w 6-63
   Diff: 3
   Skill:

64) D
   ID: oc6w 6-64
   Diff: 2
   Skill:

65) A
   ID: oc6w 6-65
   Diff: 2
   Skill:

66) E
   ID: oc6w 6-66
   Diff: 1
   Skill:

67) E
   ID: oc6w 6-67
   Diff: 1
   Skill:

68) A
   ID: oc6w 6-68
   Diff: 2
   Skill:

69) C
   ID: oc6w 6-69
   Diff: 2
   Skill:

70) B
   ID: oc6w 6-70
   Diff: 2
   Skill:

71) 3-bromo-4-ethylheptane
   ID: oc6w 6-71
   Diff: 1
   Skill:

72) E
   ID: oc6w 6-72
   Diff: 2
   Skill:
73) CH₃CH₂F < CH₃CH₂Br < (CH₃)₂CHBr < CH₃CH₂CH₂Br
   ID: oc6w 6-73
   Diff: 2
   Skill:

74) A
   ID: oc6w 6-74
   Diff: 2
   Skill:

75) CH₃C≡CCH₂CH₂CH₃, Sₐ2
   ID: oc6w 6-75
   Diff: 2
   Skill:

76) (CH₃)₃COH < (CH₃)₃CO⁻ < CH₃CH₂O⁻ < CH₃CH₂S⁻
   ID: oc6w 6-76
   Diff: 2
   Skill:

77) 2-bromo-2-methylpentane < 1-chloro-2,2-dimethylpentane < 1-chloro-3,3-dimethylpentane < bromoethane
   ID: oc6w 6-77
   Diff: 2
   Skill:

78) D
   ID: oc6w 6-78
   Diff: 2
   Skill:

79) 

   ID: oc6w 6-79
   Diff: 2
   Skill:

80) methyl iodide < isopropyl chloride < t-butyl bromide < t-butyl iodide
    ID: oc6w 6-80
    Diff: 2
    Skill:

81) PhBr < PhCH(CH₃)Br < PhCH₂Br
    ID: oc6w 6-81
    Diff: 2
    Skill:

82) PhBr < PhCH₂Br < PhCH(CH₃)Br
    ID: oc6w 6-82
    Diff: 2
    Skill:
83) A
ID: oc6w 6–83
Diff: 2
Skill:

84) The iodide ion is the better nucleophile. The larger size of this ion renders its electron cloud more polarizable.
ID: oc6w 6–84
Diff: 2
Skill:

85) E
ID: oc6w 6–85
Diff: 2
Skill:

86) 2-chlorobutane < 2-iodobutane < 1-iodobutane
ID: oc6w 6–86
Diff: 2
Skill:

87) 1-iodobutane < 2-chlorobutane < 2-iodobutane
ID: oc6w 6–87
Diff: 2
Skill:

88) Ethoxide is the better nucleophile. The steric bulk of t-butoxide decreases its effectiveness as a nucleophile.
ID: oc6w 6–88
Diff: 2
Skill:

89) No, not all primary alkyl react with N3− at the same rate via the S_N2 mechanism. Some primary iodides are more hindered than others. (CH3)3CCH2I and CH3CH2I are both primary, but (CH3)3CCH2I is significantly more hindered. Additionally, some primary iodides have increased activity due to a benzylic or allylic positioning.
ID: oc6w 6–89
Diff: 2
Skill:

90) chlorocyclopentane < iodocyclopentane < 1-iodo-1-ethylcyclopentane
ID: oc6w 6–90
Diff: 2
Skill:

91) D
ID: oc6w 6–91
Diff: 2
Skill:

92) B
ID: oc6w 6–92
Diff: 2
Skill:
93) Free Radical mechanism at the allylic C's

94) Reactivity of allylic hydrogens due to resonance stability of the radical intermediate would result in the formation of two major substitution products:

Product #2 (1-bromomethyl-cyclohexene) would be predicted to predominate in this reaction because it would form the more substituted alkene. However, radical characteristics on the secondary carbon may lead to a significant formation of product #1.