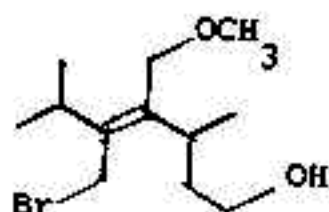


八十八學年度 原子科學 系(所) 乙 組碩士班研究生招生考試

科目 有機化學 科號 3903 共 8 頁第 1 頁 *請在試卷【答案卷】內作答

I. 選擇題 (2% of each)

1. Which of the following best describes the geometry about the carbon-carbon double bond in the alkene below?



- A. E
B. Z
C. neither E nor Z

2. How many distinct terminal alkynes exist with a molecular formula of C_5H_8 ?

- A. 1 B. 2 C. 3 D. 4 E. 5

3. Where would one expect to find the 1H NMR signal for the carboxyl group's hydrogen in propanoic acid?

- A. δ 4.1 - δ 5.6
B. δ 10 - δ 13
C. δ 8 - δ 9
D. δ 6.1 - δ 7.8
E. δ 9.5 - δ 10

4. Which of the following compounds has the most signals in the noise-decoupled ^{13}C NMR spectrum?

- A. o-dibromobenzene
B. m-dibromobenzene
C. p-dibromobenzene
D. 1,3,5-tribromobenzene
E. 1,2,3,4-tetrabromobenzene

5. Which of the following chloropyridines readily undergo nucleophilic substitution upon treatment with $NaCN$?

- A. 2-chloropyridine
B. 3-chloropyridine
C. 4-chloropyridine
D. both a and b
E. both a and c
F. both b and c

6. Which of the statements below correctly describes an achiral molecule?

- A. The molecule has a nonsuperimposable mirror image.
B. The molecule exhibits optical activity when it interacts with plane-polarized light.
C. The molecule has an enantiomer.
D. The molecule might be a meso form.
E. None of the above

八十八學年度 原子科學 系(所) _____ 組碩士班研究生招生考試

科目 有機化學 科號 3903 共 8 頁第 2 頁 *請在試卷【答案卷】內作答

7. An acid which could not be prepared from an organic halide by carboxylation of the Grignard reagent is:
- benzoic acid
 - 2,2-dimethylpropanoic acid
 - propanoic acid
 - 4-oxocyclohexanecarboxylic acid
 - 2-methylbutanoic acid
8. Which of the following alkyl halides would be suitable to use when forming a Grignard reagent?
- $\text{H}_2\text{NCH}_2\text{CH}_2\text{Br}$
 - $(\text{CH}_3)_2\text{NCH}_2\text{CH}_2\text{Br}$
 - $\text{CH}_3\text{COCH}_2\text{CH}_2\text{Br}$
 - $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{CN}$
 - all of the above
9. A sample of compound X is subjected to elemental analysis and the following percentages by weight are found: 39.97% C, 6.73% H, and 53.30% O. The molecular weight of X is 90. What is the empirical formula of X?
- $\text{C}_6\text{H}_8\text{O}_8$
 - $\text{C}_2\text{H}_4\text{O}_2$
 - $\text{C}_4\text{H}_{10}\text{O}_2$
 - $\text{C}_3\text{H}_6\text{O}_3$
 - CH_2O
10. Which of the following is a primary alkyl halide?
- methyl iodide
 - isopropyl bromide
 - t-butyl iodide
 - cyclohexyl bromide
 - isobutyl chloride
11. In the allyl radical, which π molecular orbital is singly occupied?
- The bonding π molecular orbital.
 - The nonbonding π molecular orbital.
 - The antibonding π molecular orbital.
 - None of the above.
12. The first mechanistic step in the direct reaction of an amine with a carboxylic acid to produce an amide is:
- an acid-base reaction
 - nucleophilic attack on the carbonyl carbon
 - loss of H_2O
 - loss of CO_2
 - loss of N_2
13. $\text{S}_{\text{N}}1$ reactions usually proceed with:
- equal amounts of inversion and retention at the center undergoing substitution.
 - slightly more inversion than retention at the center undergoing substitution.
 - slightly more retention than inversion at the center undergoing substitution.
 - complete inversion at the center undergoing substitution.
 - complete retention at the center undergoing substitution.

八十八學年度 原子科學 系(所) _____ 組碩士班研究生招生考試

科目 有機化學 科號 3903 共 8 頁第 3 頁 *請在試卷【答案卷】內作答

14. Which of the following terms comes closest to describing an electrophile?
- anion
 - Lewis base
 - Lewis acid
 - nucleophile
 - nonpolar
15. Which of the statements below accurately describe(s) alkanes?
- Alkanes are hydrocarbons which contain only single bonds.
 - Alkanes belong to the class of unsaturated hydrocarbons.
 - Alkanes are the simplest and least reactive class of organic compounds.
 - Both a and b.
 - Both a and c.
 - Both b and c.
16. What effect does conjugation typically have on the frequency at which absorption by C=C occurs?
- Conjugation decreases the frequency at which absorption occurs.
 - Conjugation increases the frequency at which absorption occurs.
 - Conjugation does not affect the frequency at which absorption occurs.
17. Both (E)- and (Z)-3-hexene can be treated with D_2 in the presence of a platinum catalyst. How are the products from these two reactions related to each other?
- The (E)- and (Z)-isomers generate the same products in exactly the same amounts.
 - The (E)- and (Z)-isomers generate the same products but in differing amounts.
 - The products of the two isomers are related as diastereomers.
 - The products of the two isomers are related as enantiomers.
 - The products of the two isomers are related as structural isomers.
18. _____ is the use of an optically active reagent or catalyst to convert an optically inactive starting material into an optically active product.
- Racemization
 - Asymmetric induction
 - Optical reduction
 - Meso effect
 - Heterosubstitution
19. When 1-hexanol is treated with conc. H_2SO_4 at moderate temperatures, _____ is formed via a(n) _____ mechanism.
- di-n-hexyl ether, S_N1
 - di-n-hexyl ether, S_N2
 - di-n-propyl ether, E2
 - di-n-propyl ether, E1
 - 1-hexene, S_N1

八十八學年度 原子科學 系(所) 組碩士班研究生招生考試

科目 有機化學 科號 3903 共 8 頁第 4 頁 *請在試卷【答案卷】內作答

20. Which compound would show a larger than usual M+2 peak?
 A. $\text{CH}_3\text{CH}_2\text{CN}$ B. $\text{CH}_3\text{CH}_2\text{SCH}_3$ C. $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ D. $\text{CH}_3(\text{CH}_2)_2\text{CH}_3$
21. Choose the correct hybridization for the atom indicated in the molecule below.
 $(\text{CH}_3)_2\text{CHCN}$
 ↑
 A. sp
 B. sp^2
 C. sp^3
 D. none of the above
22. How many elements of unsaturation are implied by the molecular formula $\text{C}_7\text{H}_{11}\text{Cl}$?
 A. 0 B. 1 C. 2 D. 3 E. 4 F. 5
23. In the carbon NMR, in what region of the spectrum does one typically observe carbons which are part of the aromatic ring?
 A. -10.0-0.0 ppm
 B. 40.0-60.0 ppm
 C. 80.0-100.0 ppm
 D. 120.0-150.0 ppm
 E. 200.0-220.0 ppm
24. What multiplicities are observed for the signals in the off-resonance decoupled ^{13}C spectrum of 2-chloropropene?
 A. 3 singlets
 B. 2 singlets and a doublet
 C. a singlet and 2 doublets
 D. a singlet, a doublet and a triplet
 E. a singlet, a triplet, and a quartet
 F. a doublet, a singlet, and a quartet
25. Which of the following additions to alkenes occur(s) specifically in an anti fashion?
 A. addition of Br_2
 B. hydroboration-oxidation
 C. addition of H_2
 D. addition of H_2O in dilute acid
 E. both a and b
26. Among the butane conformers, which occur at energy minima on a graph of potential energy versus dihedral angle?
 A. gauche only
 B. eclipsed and totally eclipsed
 C. gauche and anti
 D. eclipsed only
 E. anti only

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科目 有機化學 科號 3903 共 8 頁第 5 頁 請在試卷【答案卷】內作答

27. Consider the three isomeric alkanes n-hexane, 2,3-dimethylbutane, and 2-methylpentane. Which of the following correctly lists these compounds in order of increasing boiling point?
- 2,3-dimethylbutane < 2-methylpentane < n-hexane
 - 2-methylpentane < n-hexane < 2,3-dimethylbutane
 - 2-methylpentane < 2,3-dimethylbutane < n-hexane
 - n-hexane < 2-methylpentane < 2,3-dimethylbutane
 - n-hexane < 2,3-dimethylbutane < 2-methylpentane
28. Which of the following reactions involves the loss of carbon dioxide from an organic compound?
- Fischer esterification
 - Hell-Volhard-Zelinsky reaction
 - esterification with CH_2N_2
 - Hunsdiecker reaction
 - hydroboration with diborane
29. Which of the following compounds absorbs the longest wavelength of UV-visible light?
- (E)-2-butene
 - (Z)-2-butene
 - 1-hexene
 - (Z)-1,3-hexadiene
 - (E)-1,3,5-hexatriene
30. Which toluidine isomers are possible products when m-bromotoluene is treated with NaNH_2 ?
- ortho only
 - meta only
 - para only
 - meta and para only
 - ortho, meta, and para
31. Which of the molecules below can be properly called an ester?
- $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)_2$
 - $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_3$
 - CH_3COOH
 - $\text{CH}_3\text{COOCH}_3$
 - HCCCH_3
32. Which of the following undergoes $\text{S}_{\text{N}}2$ reaction with sodium methoxide most rapidly?
- PhCH_2Br
 - Ph_3CBr
 - $\text{PhCH}_2\text{CH}_2\text{Br}$
 - PhBr
 - $\text{PhCH}_2\text{CH}_2\text{CH}_2\text{Br}$

八十八學年度 原子科學 系(所) _____ 組碩士班研究生招生考試

科目 有機化學 科號 3903 共 8 頁第 6 頁 *請在試卷【答案卷】內作答

33. When the carbonyl group of a neutral ketone is protonated,:
- the resulting species becomes more electrophilic.
 - the resulting species is activated toward nucleophilic attack.
 - subsequent nucleophilic attack on the resulting species is said to occur under acid-catalyzed conditions.
 - the resulting species has a positive charge.
 - all of the above.
34. Which of the species below is less basic than acetylide?
- CH_3Li
 - CH_3ONa
 - NaOH
 - both b and c
 - all of the above
35. Which of the following amines is most soluble in water?
- $\text{CH}_3\text{CH}_2\text{NH}_2$
 - PhNH_2
 - $(\text{CH}_3)_3\text{N}$
 - $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{NH}$
 - pyrrolidine
36. Which is a measure of the randomness of a system?
- enthalpy
 - entropy
 - kinetic order
 - free energy
 - catalyst
37. When (R)-2-butanol is treated with TsCl in pyridine, the product formed is:
- an achiral compound.
 - a mixture of diastereomers.
 - a racemic mixture.
 - a single enantiomer.
 - none of the above.
38. In electrophilic aromatic substitution reactions a chlorine substituent:
- is a deactivator and a m-director.
 - is a deactivator and an o,p-director.
 - is an activator and a m-director.
 - is an activator and an o,p-director.
 - none of the above
39. 2-Methyl-3-pentanol is classified as _____.
- a primary alcohol
 - a secondary alcohol
 - a tertiary alcohol
 - none of the above

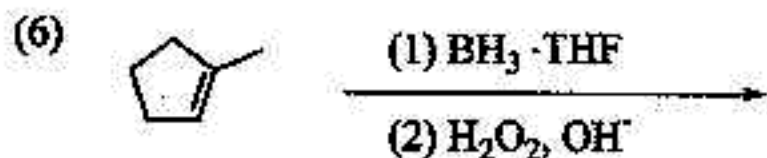
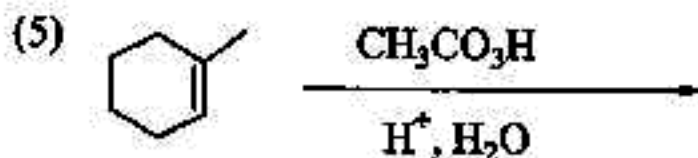
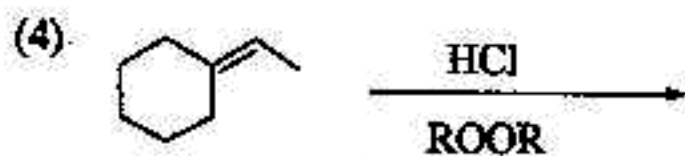
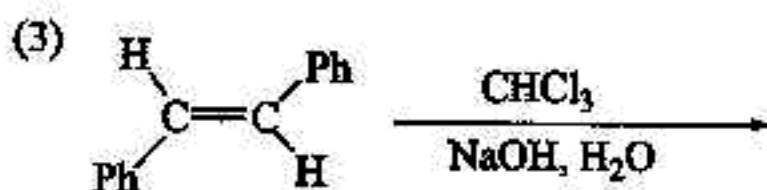
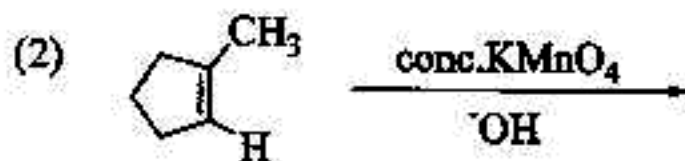
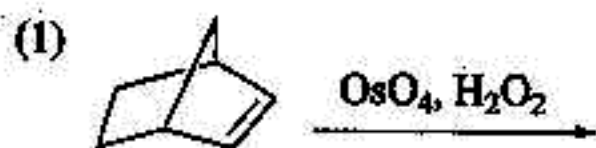
八十八學年度 原子科學系 (所) 組碩士班研究生招生考試

科目 有機化學 科號 3903 共 8 頁第 7 頁 *請在試卷【答案卷】內作答

40. Why do acetal-forming reactions that use ethylene glycol have more favorable equilibrium constants than those using methanol?

- A. Ethylene glycol reacts more rapidly.
- B. They are more favorable on entropy grounds.
- C. They are more favorable on enthalpy grounds.
- D. Ethylene glycol is acidic and catalyzes the reaction.
- E. The ethylene acetal can serve as a protecting group.

II. Predict the major products of the following reactions. Include stereochemistry where appropriate. (2% of each)



八十八學年度 原子科學系 系(所) _____ 組碩士班研究生招生考試

科目 有機化學 科號 3903 共 8 頁第 8 頁 *請在試卷【答案卷】內作答

