

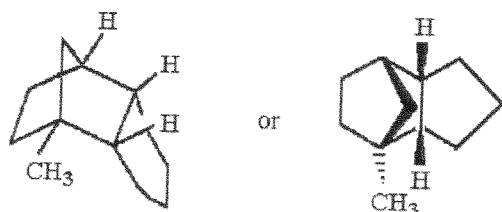
國立清華大學命題紙

98 學年度 生醫工程與環境科學系 (所) 甲 組碩士班入學考試

科目 有機化學 科目代碼 2304 共 7 頁第 / 頁 *請在【答案卷】內作答

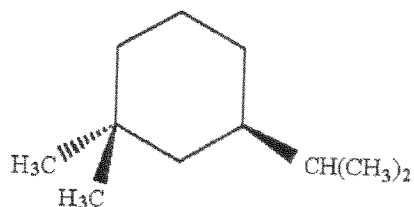
總分 100分; 共 42題; No. 1-32: 64分; No. 33-36: 12分; No. 37-42: 24 分
考試時間 100 分鐘
共 5 頁第 1 頁

1) In the hydrocarbon shown below, how many tertiary hydrogens are present?



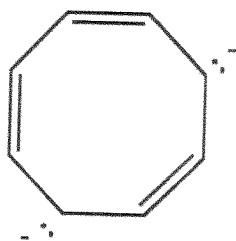
- A) 0 B) 1 C) 2 D) 3 E) 4

2) How many asymmetric carbon atoms are present in the following compound?



- A) 0 B) 1 C) 2 D) 3 E) 4

3) Classify the compound below as aromatic, antiaromatic, or nonaromatic. Assume planarity of the π network.



4) The conjugate acid of ammonia, NH_3 , is:

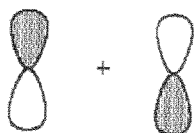
- A) NH_4^+ B) NH_2^- C) NH_2OH D) none of the above

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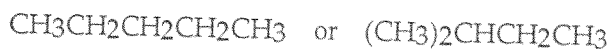
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科目 有機化學 科目代碼 2304 共 7 頁第 2 頁 *請在【答案卷】內作答

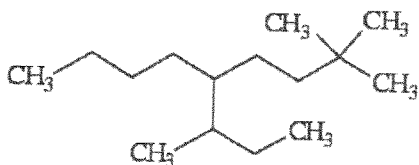
- 5) What kind of molecular orbital (σ , σ^* , π , or π^*) results when the two atomic orbitals shown below interact in the manner indicated?



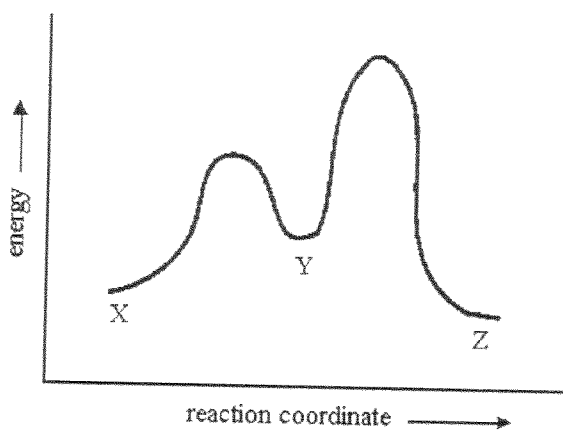
- 6) Which of the molecules below has the higher boiling point? Briefly explain your choice.



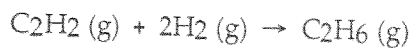
- 7) Provide an acceptable name for the alkane shown below.



- 8) Consider the conversion of X to Z through the sole intermediate Y. Given the reaction-energy diagram shown below, which step is the rate-limiting step? Explain your reasoning.



- 9) The hydrogenation of acetylene to produce ethane is shown below. Is ΔS° for this reaction positive, negative, or impossible to predict? Explain your reasoning.

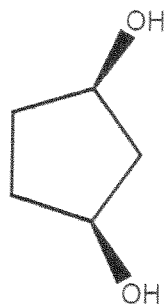


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科目 有機化學 科目代碼 2304 共 7 頁第 3 頁 *請在【答案卷】內作答

10) How many enantiomers are there of the molecule shown below?

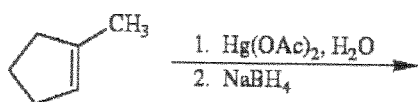


- A) 1 B) 3 C) 0 D) 6 E) 2

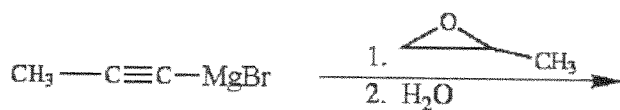
11) Draw the structure of the enantiomer of (2*S*, 3*R*)-2,3-dichloropentane. Take particular care to indicate three-dimensional stereochemical detail properly.

12) Provide the structure of the major organic product which results when (5*S*)-2-iodopentane is treated with KCN in DMF.

13) Draw the major organic product generated in the reaction below. Pay particular attention to regio- and stereochemical detail.



14) Provide the structure of the major organic product(s) in the reaction below.



15) Provide the structure of the major organic product(s) in the reaction below.



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



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17) Which compound would be expected to show intense IR absorption at 3363, 3185, 1660 cm^{-1} ?
A) $(\text{CH}_3)_2\text{CHNH}_2$ B) $\text{CH}_3\text{CH}_2\text{CONH}_2$ C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ D) but-1-ene

18) Absorption of what type of electromagnetic radiation results in electronic transitions?

- A) microwaves
- B) ultraviolet light
- C) X-rays
- D) infrared light
- E) radio waves

19) Deduce the identity of the following compound from the ^1H NMR data given.

$\text{C}_9\text{H}_{10}\text{O}_2$; δ 2.2 (3H, singlet), 5.0 (2H, singlet), 7.2 (5H, singlet) (ppm)

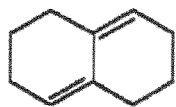
20) Deduce the identity of the following compound from the spectral data given.

C_8H_{10} : ^1H NMR, δ 1.20 (3H, triplet), 2.60 (2H, quartet), 7.12 (5H, singlet) (ppm); IR, 3050, 2970, 1600 cm^{-1} ; MS, m/z 91

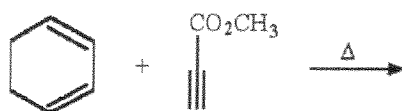
21) Show the best method for preparing 4-propoxytoluene via the Williamson ether synthesis.

22) Give a representation of the highest occupied π MO of 1,3-butadiene in its ground state.

23) Provide the structure of the major product which results from 1,2-addition of HBr to the diene shown below.



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



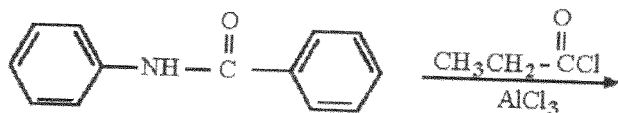
25) How many pairs of degenerate π molecular orbitals are found in benzene?

- A) 5
- B) 3
- C) 2
- D) 4
- E) 6

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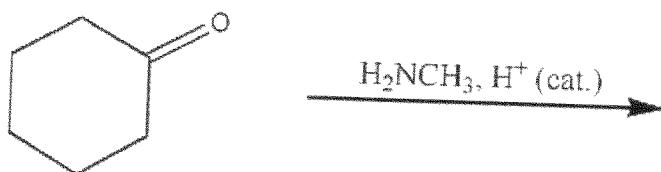
26) Provide the structure of the major organic product of the following reaction.



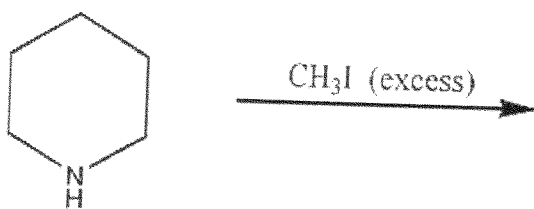
27) Which of the following represents the correct ranking in terms of increasing boiling point?

- A) *n*-butane < 2-butanone < diethyl ether < 1-butanol
- B) *n*-butane < 1-butanol < diethyl ether < 2-butanone
- C) 2-butanone < *n*-butane < diethyl ether < 1-butanol
- D) *n*-butane < diethyl ether < 2-butanone < 1-butanol
- E) *n*-butane < diethyl ether < 1-butanol < 2-butanone

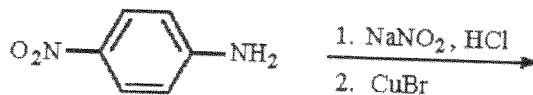
28) Provide the major organic product of the following reaction.



29) Provide the major organic compound in the following reaction.



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



31) Which of the following compounds is the strongest acid?

- A) *m*-methylbenzoic acid
- B) water
- C) *p*-bromobenzoic acid
- D) *p*-nitrobenzoic acid
- E) *m*-methoxybenzoic acid

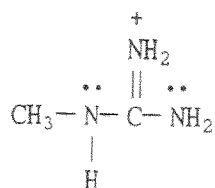
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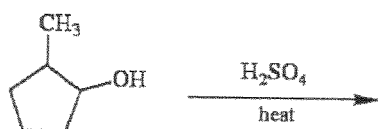
32) Provide a detailed, stepwise mechanism for the reaction of propanoic anhydride with phenol.

33) Draw the important resonance forms for the structure shown below.



34) View a butane molecule along the C2-C3 bond and provide a Newman projection of the lowest energy conformer.

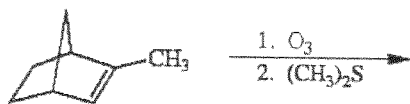
35) Draw all likely products of the following reaction and circle the product you expect to predominate.



36) Draw the major organic product generated in the reaction below. Pay particular attention to regio- and stereochemical detail.



37) Draw the major organic product generated in the reaction below. Pay particular attention to regio- and stereochemical detail.



38) Describe a sequence of reactions by which meso-2,3-dibromobutane can be straightforwardly prepared from propyne.

39) Provide a detailed, stepwise mechanism for the reaction of benzene with Br_2 and FeBr_3 . Make sure to include the activating reaction between Br_2 and FeBr_3 in your mechanism.

40) Devise an efficient method for preparing 3-bromotoluene from toluene.

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- 41) Suggest a sequence of synthetic steps through which phenylacetic acid can be prepared from toluene via phenylacetonitrile.
- 42) Propose a synthesis of PhNHCHO from benzene.