國立臺北科技大學

九十三學年度有機高分子研究所入學考試

有機化學試題

填准考證號碼

注意事項：

1. 本試題共 40 題，每題 2.5 分(答錯扣 1 分)，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. According to molecular orbital theory, which molecule could not exist?
   (a) H_2 (b) He_2 (c) Li_2 (d) N_2 (e) F_2

2. What shape dose the methyl cation have?
   (a) Octahedral (b) Tetrahedral (c) Trigonal planar (d) Linear (e) T-shape

3. Which of the following is not Lewis base?
   (a) NH_3 (b) H^- (c) H_2O (d) BF_3 (e) H_3C^-

4. Select the reagents necessary to convert cyclopentene into cyclopentane.
   (a) H_2 and Ni (b) H_2O (c) Heat (d) Zn, H_3O^+ (e) Light

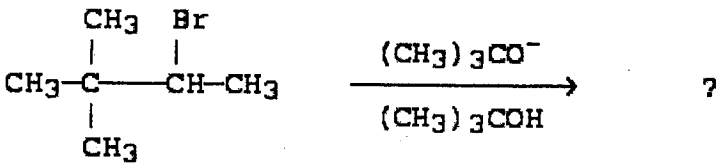
5. How many constitutional isomers are possible for the formula C_6H_{14}?
   (a) 2 (b) 3 (c) 4 (d) 5 (e) 6

6. Which is a meso compound?
   (a) (2R, 3R)-2,3-Dibromobutane
   (b) (2R, 3S)-2,3-Dibromopentane
   (c) (2R, 4R)-2,4-Dibromopentane
   (d) (2R, 4S)-2,4-Dibromopentane
   (e) None of these

7. The rate equation for an S_N1 reaction of an alkyl bromide (R-Br) with I^- ion would be:
(a) Rate = k [RBr] (b) Rate = k [I^-] (c) Rate = k [RBr][I^-]
(d) Rate = k [RBr]^2[I^-] (e) Rate = k [RBr][I^-]^2

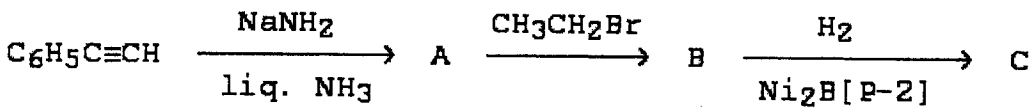
8. Which is the weakest nucleophile in polar aprotic solvents?
(a) I^- (b) Br^- (c) Cl^- (d) F^-

9. What is the major product of the reaction,



(a) $(CH_3)_2C{=}C(CH_3)_2$ (b) $(CH_3)_3C{-}CH{=}CH_2$ (c) $(CH_3)_2C{=}CHCH_3$
(d) $(CH_3)_2C{=}CHCH_2CH_3$ (e) $(CH_3)_2CCH_2CH_3$

10. The structure of the product, C, of the following sequence of reactions would be:



(a) *cis*–$CH_3CH_2CH{=}CHC_6H_5$ (b) *cis*–$CH_3CH{=}CHC_6H_5$
(c) *trans*–$CH_3CH_2CH{=}CHC_6H_5$ (d) $C_6H_5C{\equiv}CCH_2CH_2Br$
(e) $C_6H_5C{\equiv}CCH_2CH_3$

11. Your task is to convert 2-bromobutane to 1-butene in highest yield. Which reagents would you use?
(a) KOH/H_2O (b) KOH/CH_3OH (c) CH_3ONa/CH_3OH
(d) CH_3CH_2ONa/CH_3CH_2OH (e) $(CH_3)_3COK/(CH_3)_3COH$

12. Compute the index of hydrogen deficiency for the molecule $C_{10}H_8$.
(a) 3 (b) 4 (c) 5 (d) 6 (e) 7

13. Which of the following correctly lists the compounds in order of decreasing acidity?
(a) H_2O > $HC{\equiv}CH$ > NH_3 > CH_3CH_3
(b) $HC{\equiv}CH$ > H_2O > NH_3 > CH_3CH_3
(c) CH_3CH_3 > $HC{\equiv}CH$ > NH_3 > H_2O
(d) CH_3CH_3 > $HC{\equiv}CH$ > H_2O > NH_3
(e) H_2O > NH_3 > $HC{\equiv}CH$ > CH_3CH_3

14. An optically active compound, Y, with the molecular formula C_7H_{12} gives a positive test

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(d) $NaNH_2$ > CH_3CH_2MgBr > $HC{\equiv}CNa$ > CH_3CH_2ONa > NaOH

(e) None of these

28. Which of these is the least reactive type of organometallic compound?

(a) RK (b) R_2Hg (c) RLi (d) R_2Zn (e) R_3Al

29. A thermodynamically-controlled reaction will yield predominantly:

(a) The more/most stable product.

(b) The product whose formation requires the smallest free energy of activation.

(c) The product that can be formed in the fewest steps.

(d) The product that is formed at the fastest rate.

(e) the product which possesses the greatest potential energy.

30. Which is an untrue statement concerning the Diels-Alder reaction?

(a) The reaction is a *syn* addition.

(b) The diene must be in the *s-cis* conformation to react.

(c) Most Diels-Alder reactions are reversible.

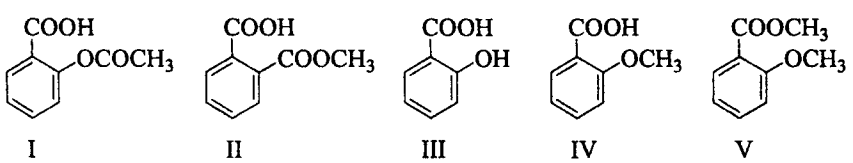
(d) Generally, the adduct formed most rapidly is the *exo* product.

(e) Depending on the nature of the dienophile, both electron-releasing and electron-withdrawing groups in the diene can favor adduct formation.

31. Consider the molecular orbital model of benzene. In the ground state how many molecular orbitals are filled with electrons?

(a) 6 (b) 5 (c) 4 (d) 3 (e) 2

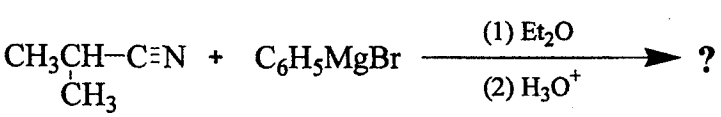
32. Which one is the correct structure of aspirin?



I II III IV V

(a) I (b) II (c) III (d) IV (e) V

33. What is the product of the reaction



(a) $(CH_3)_2CHCH(OH)C_6H_5$ (b) $(CH_3)_2CHC(O)C_6H_5$

(c) $(CH_3)_2CHCH(NH_2)C_6H_5$ (d) $(CH_3)_2CHCH_2N(C_6H_5)_2$

(e) $(CH_3)_2CHCH_2NH(C_6H_5)$

(d) $Br\cdot + H{-}Cl \rightarrow H{-}Br + Cl\cdot$

(e) $Br\cdot + H{-}I \rightarrow H{-}Br + I\cdot$

22. In the presence of light, ethane (1 mol) reacts with chlorine (1 mol) to form which product(s)?

(a) $CH_2ClCHCl_2$ (b) CH_3CHCl_2 (c) CH_3CH_2Cl (d) $ClCH_2CH_2Cl$ (e) All of these

23. What is the product of the reaction

$$CH_3CH_2CH{=}CH_2 + CBr_4 \xrightarrow{\text{peroxides}} ?$$

(a) $CH_3CH_2CH{=}CHCBr_3$ (b) $CH_3CH_2CH(Br)CH_2CBr_3$ (c) $CH_3CH_2CH(CBr_3)CH_2Br$

(d) $CH_3CH_2CH_2CH(Br)CBr_3$ (e) No reaction occurs.

24. Which is the best way to prepare isopropyl methyl ether via the Williamson method?

(a) $CH_3OH + (CH_3)_2CHOH + H_2SO_4$, 140 ℃

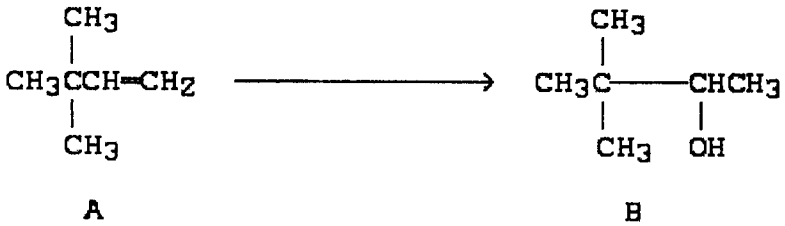
(b) $CH_3OH + (CH_3)_2CHCH_2OH + H_2SO_4$, 140 ℃

(c) $CH_3ONa + (CH_3)_2CHI$

(d) $CH_3I + (CH_3)_2CHONa$

(e) $CH_3I + (CH_3)_2CHCH_2ONa$

25. Which would be the best method for converting A into B



A B

(a) H_3O^+, heat (b) BH_3:THF; then H_2O_2, OH^- (c) concd. H_2SO_4; then H_2O, heat

(d) $Hg(OAc)_2$/THF-H_2O; then $NaBH_4$,OH^- (e) HBr; then NaOH/H_2O

26. The reaction of lithium di-*sec*-butylcuprate with isopentyl bromide yields:

(a) 2,5-Dimethylheptane (b) 2,6-Dimethylheptane (c) 3,5-Dimethylheptane

(d) 3,4-Dimethylheptane (e) 3,6-Dimethylheptane

27. In which of the following series are the compounds arranged in order of decreasing basicity?

(a) $CH_3CH_2MgBr > NaNH_2 > HC{\equiv}CNa > NaOH > CH_3CH_2ONa$

(b) $CH_3CH_2MgBr > NaNH_2 > HC{\equiv}CNa > CH_3CH_2ONa > NaOH$

(c) $HC{\equiv}CNa > CH_3CH_2MgBr > NaNH_2 > CH_3CH_2ONa > NaOH$

with cold dilute $KMnO_4$ and shows IR absorption at 3300 cm^{-1}. On catalytic hydrogenation, Y yields $Z(C_7H_{16})$ and Z is also optically active. Which is a possible structure for Y?

(a) $CH_3CH_2CH_2CH_2CH_2C{\equiv}CH$

(b) $CH_3CH(CH_3)CH_2CH_2C{\equiv}CH$

(c) $CH_3CH_2CH(CH_3)CH_2C{\equiv}CH$

(d) $CH_3CH_2CH(CH_3)C{\equiv}CCH_3$

(e) $CH_2{=}CHCH(CH_3)CH_2CH{=}CH_2$

15. An alkene with the molecular formula C_8H_{16} undergoes ozonolysis to yield acetone and $(CH_3)_3CCHO$. The alkene is:

(a) 2,2-Dimethyl-2-hexene (b) 2,3-Dimethyl-2-hexene (c) 2,4-Dimethyl-2-hexene

(d) 2,4,4-Trimethyl-2-pentene (e) More than one of the above is a possible answer.

16. What is the chief product of the reaction of IBr with 1-butene?

(a) $CH_3CH_2CH(Br)CH_2I$ (b) $CH_3CH_2CH(I)CH_2Br$ (c) $CH_3CH_2CH(Br)CH_2Br$

(d) $CH_3CH_2CH(I)CH_2I$ (e) $CH_3CH(I)CH(Br)CH_3$

17. Which reaction of an alkene proceeds with anti addition?

(a) Hydroboration/oxidation (b) Bromination (c) Permanganate oxidation

(d) Hydrogenation (e) Epoxidation

18. A compound with the molecular formula C_8H_9BrO gave the following ^1H NMR spectrum: δ 1.4 (triplet), δ 3.9 (quartet), and δ 7.0 (multiplet, 4H). There was no evidence of an -OH band in the IR spectrum. A possible structure for the compound is:

(a) $C_6H_5OCH_2CH_2Br$ (b) *p*-$CH_3C_6H_4OCH_2Br$ (c) *p*-$BrC_6H_4OCH_2CH_3$

(d) $C_6H_5OCH(Br)CH_3$ (e) *p*-$CH_3OC_6H_4CH_2Br$

19. How many signals will be recorded in the broadband proton-decoupled ^{13}C NMR spectrum of 4-chloro-1-ethylbenzene?

(a) 2 (b) 3 (c) 4 (d) 6 (e) 7

20. Which form of electromagnetic radiation possesses the least energy?

(a) Radiofrequency (b) Infrared (c) Visible (d) UV (e) X-ray

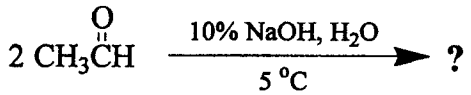
21. Which of the following reactions would have $E_{act} = 0$?

(a) $CH_3\cdot + (CH_3)_3C{-}H \rightarrow CH_4 + (CH_3)_3C\cdot$

(b) $CH_3\cdot + CH_3CH_3 \rightarrow CH_4 + CH_3CH_2\cdot$

(c) $CH_3CH_2\cdot + CH_3CH_2\cdot \rightarrow CH_3CH_2CH_2CH_3$

34. What is the product of the reaction

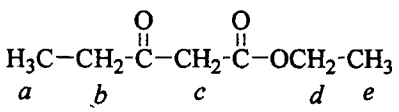


(a) $CH_3C(O)C(O)CH_3$ (b) $CH_3C(O)CH_2CHO$ (c) $CH_3CH(OH)CH_2CH_2OH$
(d) $CH_3C(O)CH_2CH_2OH$ (e) $CH_3CH(OH)CH_2CHO$

35. Which one is the most reactive toward nucleophilic addition-elimination?
(a) Ketone (b) Acyl halide (c) Acid anhydride (d) Ester (e) Amide

36. Which reagent would serve as the basis for a simple chemical test to distinguish between hexanoic acid and hexanamide?
(a) Cold dilute NaOH (b) Cold dilute $NaHCO_3$ (c) Cold concd H_2SO_4
(d) More than one of these (e) None of these

37. Which hydrogen atoms in the following ester are most acidic?



(a) *a* (b) *b* (c) *c* (d) *d* (e) *e*

38. Which of the following compounds would be most reactive toward ring bromination?
(a) $-C_6H_5$ (b) $-NO_2$ (c) $-N(CH_3)_3^+$ (d) $-C\equiv N$ (e) $-CO_2H$

39. Which reagent(s) could be used to carry out the following reaction?

Cyclopentane → 3-Bromocyclopentene

(a) $Br_2/h\nu$, then $(CH_3)_3COK/(CH_3)_3COH$, then NBS/CCl_4
(b) $(CH_3)_3COK/(CH_3)_3COH$, then NBS/CCl_4
(c) NBS/CCl_4, then $(CH_3)_3COK/(CH_3)_3COH$, then $Br_2/h\nu$
(d) NBS/CCl_4
(e) NBS/CCl_4, then $Br_2/h\nu$

40. The formal charge on N in the compound $F_3B—NH_3$ is
(a) -2 (b) -1 (c) 0 (d) +1 (e) +2