

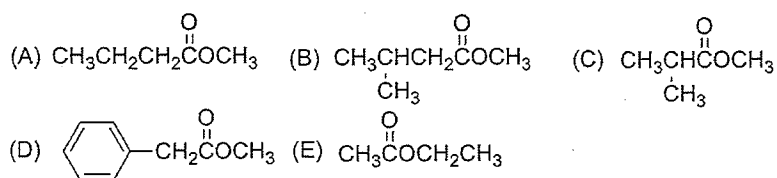
國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：有機化學及無機化學【化學系碩士班】

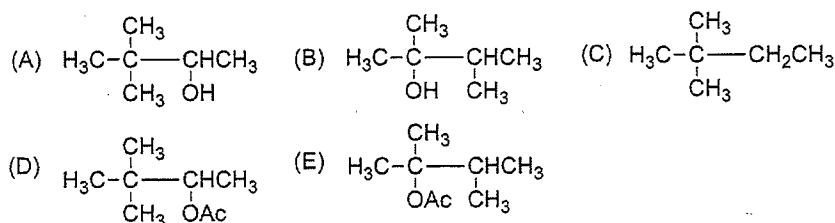
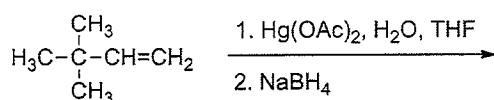
題號：4043
共 4 頁 第 1 頁

單選題 (2% × 31 = 62%)

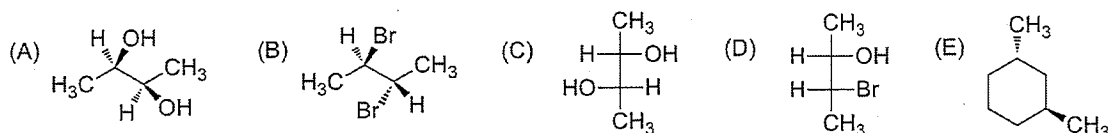
1. Which of the following esters can not produce Claisen condensation product?



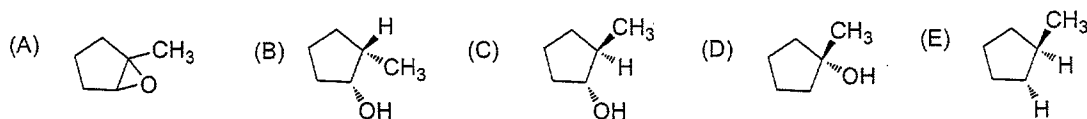
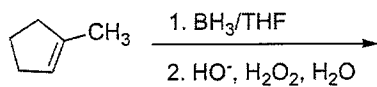
2. What is the major product of the following reaction?



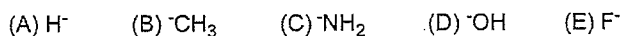
3. Which of the following compounds is a *meso* compound?



4. What is the major product of the following reaction?



5. Which of the following anions is the strongest Bronsted base?

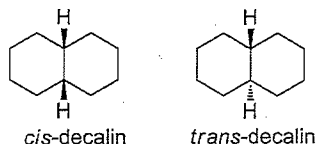


國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：有機化學及無機化學【化學系碩士班】

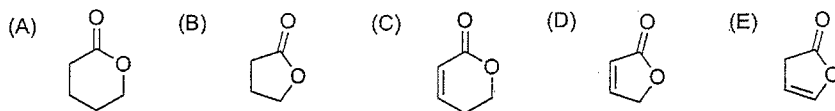
題號：4043
共 4 頁 第 2 頁

6. *cis*-Decalin is less stable than *trans*-decalin. Assume that the 1,3-diaxial interactions in *cis*-decalin are similar to those in axial methylcyclohexane [that is, one CH₂ and H interaction costs 0.9 kcal/mol], and what is the energy difference between *cis*- and *trans*-decalin.



- (A) 0.9 kcal/mol (B) 1.8 kcal/mol (C) 2.7 kcal/mol (D) 3.6 kcal/mol (E) 4.5 kcal/mol

7. Which of the following lactones shows the highest C=O stretching absorption frequency?



8. Which of the following substituents should be assigned as the highest priority according to the Cahn-Ingold-Prelog sequence rule?

- (A) -CH=CH₂ (B) -CN (C) -CH₂NH₂ (D) -CH₂Br (E) -CO₂H

9. When electron-impact ionization is used, the Mass spectrum of 2,2-dimethylpropane shows many fragment ions. Which of the following would you expect to be the base peak?

- (A) $m/z = 15$ (B) $m/z = 29$ (C) $m/z = 41$ (D) $m/z = 57$ (E) $m/z = 72$

10. Which of the following nucleophiles is most reactive toward CH₃I in methanol?

- (A) CH₃O⁻ (B) NH₃ (C) F⁻ (D) Br⁻ (E) CH₃S⁻

11. The fragment Ru(CO)₃ is isolobal with: (A) CH (B) CH₂ (C) BH (D) BH₂ (E) NH.

12. Pick the complex having Jahn-Teller effect: (A) Fe(OH₂)₆²⁺ (B) Co(OH₂)₆²⁺ (C) Ni(OH₂)₆²⁺ (D) Cu(OH₂)₆⁺ (E) Zn(OH₂)₆²⁺.

13. Pick the lowest C-O stretching frequency: (A) Ti(CO)₆²⁻ (B) V(CO)₆⁻ (C) Cr(CO)₆ (D) Mn(CO)₆⁺ (E) Fe(CO)₆²⁺.

14. Determine the number of IR-active O-H stretching bands for H₃O⁺: (A) 0 (B) 1 (C) 2 (D) 3 (E) 4.

15. The point group of tungsten hexahydride is: (A) O_h (B) T_d (C) C_{2v} (D) C₃ (E) none of the above.

16. Pick the molecule having C_{2v} symmetry: (A) PCl₅ (B) PFCl₄ (C) PF₂Cl₃ (D) PF₃Cl₂ (E) PF₃.

17. For a hydrogen atom, assuming its 2p orbital energy is E, estimate its 5d orbital energy: (A) 5E/2 (B) 2E/5 (C) 25E/4 (D) 4E/25 (E) none of the above.

18. Pick the molecule or ion that is chiral: (A) OH⁻ (B) H₂O (C) H₂O₂ (D) H₃O⁺ (E) none of the above.

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：有機化學及無機化學【化學系碩士班】

題號：4043
共 4 頁 第 3 頁

19. Pick the ion that is diamagnetic: (A) O_2^- (B) O_2^{2-} (C) N_2^- (D) N_2^{2-} (E) N_2^{3-} .
20. Estimate the spin-only magnetic moment (in B.M.) of $Os(OH_2)_6^{3+}$: (A) 0 (B) 1.41 (C) 1.73 (D) 2.83 (E) none of the above.
21. Determine the ground-state free-ion term for $Ni(OH_2)_6^{2+}$: (A) 3F_4 (B) 3F_2 (C) 3D_4 (D) 3D_2 (E) none of the above.
22. Pick the most labile compound in the following: (A) $Mn(\eta^5-C_5H_5)_2$ (B) $Fe(\eta^5-C_5H_5)_2$ (C) $Co(\eta^5-C_5H_5)_2$ (D) $Ni(\eta^5-C_5H_5)_2$ (E) they are equally stable.
23. Pick the highest Re-Re bond order in the following: (A) $[Re_2Cl_4(PMe_2Ph)_4]$ (B) $[Re_2Cl_4(PMe_2Ph)_4]^+$ (C) $[Re_2Cl_4(PMe_2Ph)_4]^{2+}$ (D) $[Re_2Cl_4(PMe_2Ph)_4]^{3+}$ (E) they all have the same Re-Re bond order.
24. Pick the fragment that is isolobal with phosphorus: (A) $Pd(CO)_3$ (B) $PtCl_3^-$ (C) $Re(CO)_4$ (D) $Fe(\eta^5-C_5H_5)(CO)_2$ (E) $Ni(\eta^5-C_5H_5)$.
25. Determine the number of framework orbitals for B_8H_{16} : (A) 11 (B) 12 (C) 13 (D) 14 (E) 15.
26. Pick the strongest base from the following in reactions with trimethylboron: (A) pyridine (B) 2-methylpyridine (C) 4-methylpyridine (D) 2-*tert*-butylpyridine (E) 4-*tert*-butylpyridine.
27. Pick the highest emission frequencies for ZnSe quantum dots with the following diameters (in nm): (A) 10 (B) 30 (C) 50 (D) 100 (E) they all have identical emission frequencies.
28. Where distinguishable, pick the strongest acid from the following: (A) HF (B) H_2SO_3 (C) H_2SO_4 (D) $HClO_4$ (E) HSO_3F .
29. Schrock carbenes are characteristic of (A) containing late transition metals (B) containing metals with lowest possible oxidation states (C) containing β -heteroatoms (D) containing nucleophilic α -carbon (E) containing nucleophilic α -hydrogen.
30. Assuming the ionization energy of a hydrogen atom is E , estimate the 4f orbital energy for a Li^{2+} cation: (A) $3E/4$ (B) $-3E/4$ (C) $9E/16$ (D) $-9E/16$ (E) $E/4$.
31. The electron count of tungsten hexamethyl is: (A) 12 (B) 14 (C) 16 (D) 18 (E) 20.

國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：有機化學及無機化學【化學系碩士班】

題號：4043
共 4 頁 第 4 頁

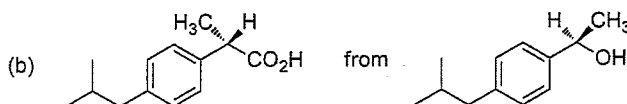
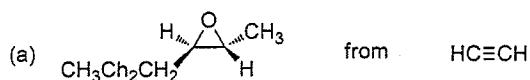
非選擇題 (38%)

I. Reactivity and Statement (2% × 4 = 8%):

- Give the formula of all products from the reaction of $\text{Mn}(\text{CO})_5(\text{Me})$ with CO .
- Give the formula of all products from the thermolysis reaction of $\text{Ta}(\text{CH}_2\text{CMe}_3)_5$.
- Explain briefly why two separate water exchange rates are found for $[\text{Cu}(\text{H}_2\text{O})_6]^{+2}$ in aqueous solution.
- Explain briefly why CO and N_2 are isoelectronic but exhibit dramatically different reactivity. Which one is more reactive?

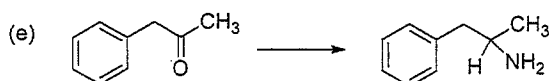
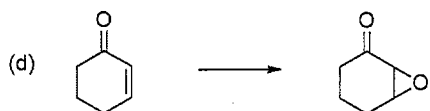
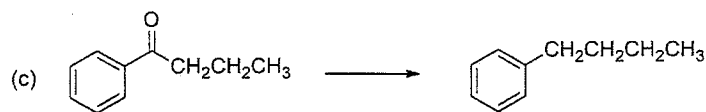
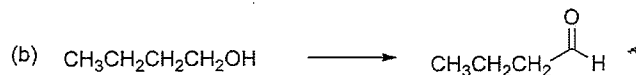
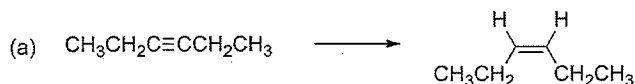
II. Synthesis questions. (5% × 2 = 10%)

How would you prepare the following compounds from the given starting materials? More than one step may be required. Also indicate clearly all the other common reagents needed for the transformation in each step.



III. Reagent questions. (3% × 5 = 15%)

What reagents would you use to accomplish each the following transformation?



IV. Mechanism question. (5% × 1 = 5%)

Propose a reasonable mechanism for the following reaction. Be sure that your diagrams clearly show what you want your answer to mean.

