※注意：本試題分有機化學與無機化學兩部分，各佔 **50** 分。
選擇題部分請務必作答於答案卷首頁之「選擇題作答區」。
問答題部分則請務必依序作答於答案卷之「非選擇題作答區」。

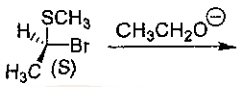
有機化學

一、單選題 (共 18 題，每題 2 分，答錯倒扣 1 分)。

1. For S_N2 reactions, which of the following statements is CORRECT?

A. For a given S_N2 reaction in polar protic solvent usually gives a higher reaction rate than that of in polar *aprotic solvent.*

B. The following reaction will give a product with *S* configuration.



C. (*R*)-CH_3CH_2CHDI reacts with NaI in acetone gives (*S*)-CH_3CH_2CHDI

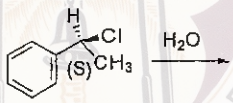
D. $(CH_3)_3OH$ p*K*a = 18, CH_3OH p*K*a = 15.5 in water, accordingly, $(CH_3)_3O^-$ should give a higher rate than CH_3O^- toward a secondary alkyl bromide.

2. For S_N1/E1 reactions, which of the following statements is INCORRECT?

A. The S_N1/E1 reactions proceed through the same carbocation intermediate.

B. For a given secondary alkyl bromide in water, lower the reaction temperature favors the S_N1 product.

C. The following S_N1 reaction will give a racemic product.

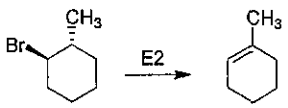


D. For E1 product, the most substituted alkenes normally is the major one.

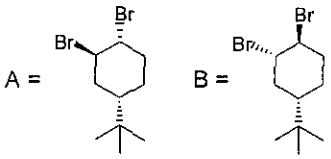
3. For E2 reactions, which of the following statements is CORRECT?

A. (*R,R*)-2,3-dibromobutane undergoes E2 reaction will give an *E*-alkene.

B. The product of the following reaction is correct.

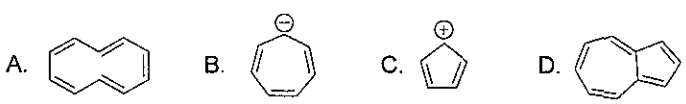


C. Dehalogenation of 1,2-dihalides with I^- has an E2-like transition state. For the following two substrates A and B, in which A undergoes dehalogenation with I^- faster than B.

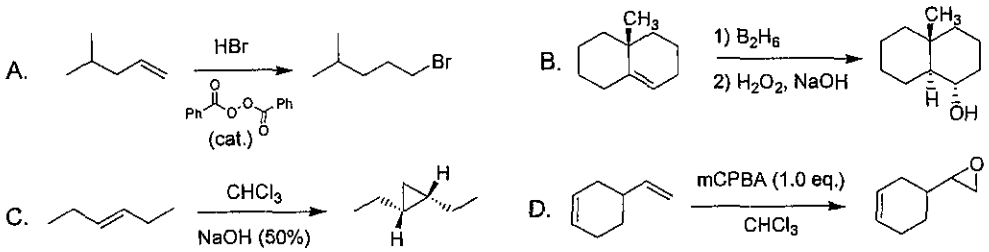


D. The nature of leaving group is unimportant in the reaction rate of E2 reaction.

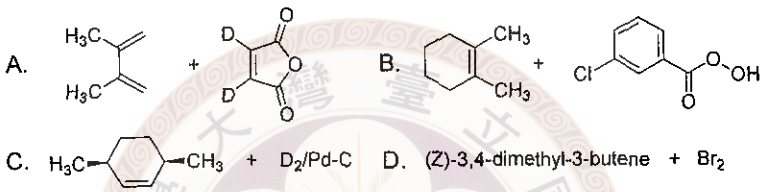
4. According to the Hückel rule, which of the following compounds is AROMATIC?



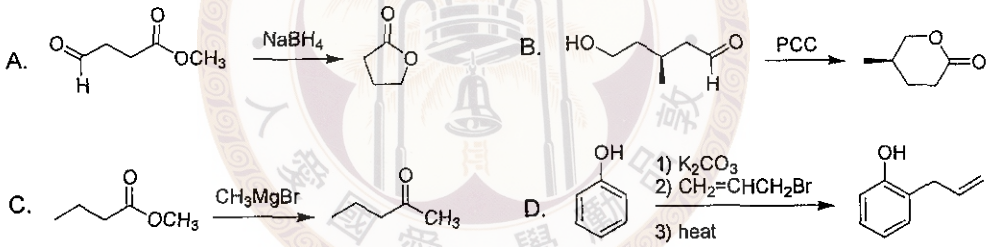
5. Which of the following reaction WILL give the indicated product?



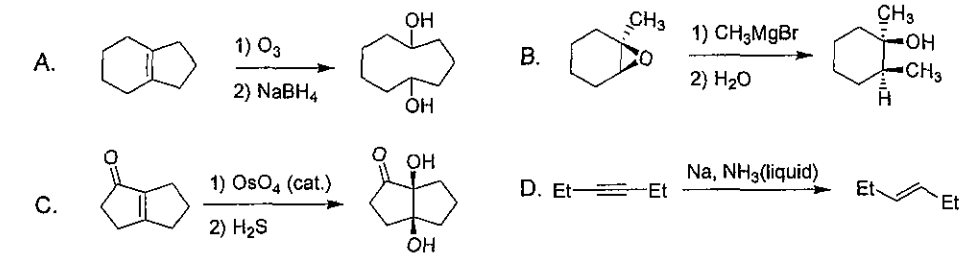
6. Which of the following reactions WILL NOT give a meso product?



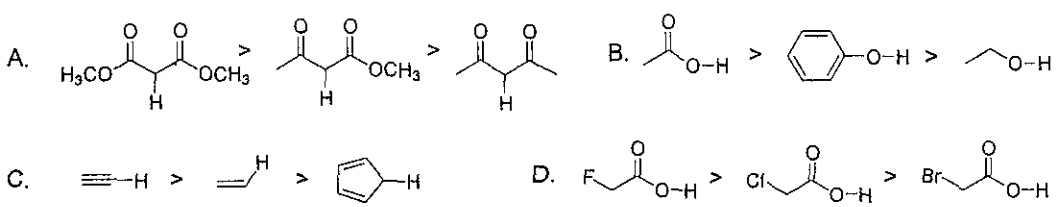
7. Which of the following reactions WILL NOT give the indicated product?



8. Which of the following reactions WILL NOT give the indicated product?



9. For p*Ka*, which of the following comparisons is CORRECT?



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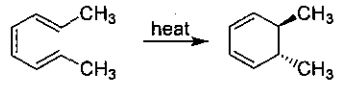
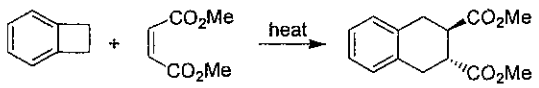
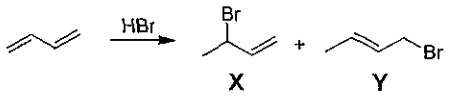
10. Which of the following reactions WILL give the indicated product?

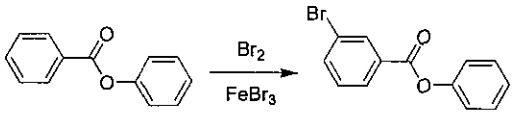
A. 

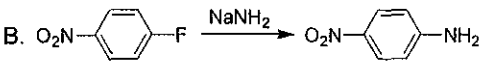
B. 

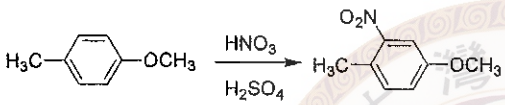


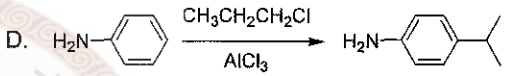
C. at 40 °C, X is the major product　　D. at 0 °C, Y is the major product

11. Which of the following reactions WILL give the indicated product?

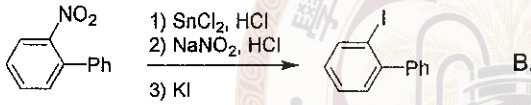
A. 

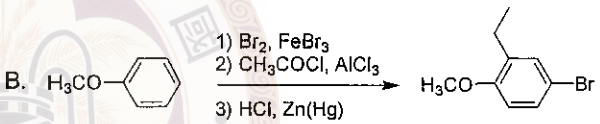
B. 

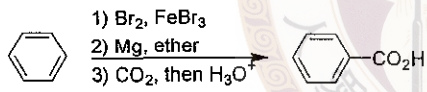
C. 

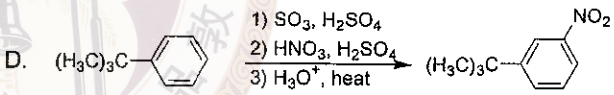
D. 

12. Which of the following multi-step synthesis WILL NOT give the indicated product?

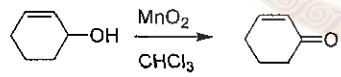
A. 

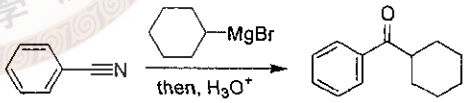
B. 

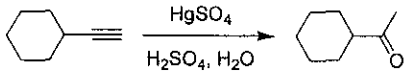
C. 

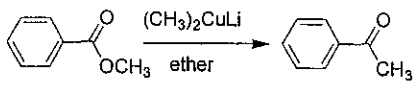
D. 

13. Which of the following synthesis WILL NOT give the indicated product?

A. 

B. 

C. 

D. 

14. Which of the following statements is CORRECT?

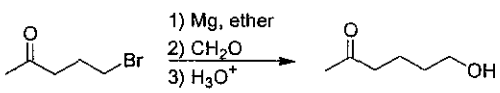
A. Among the tripeptides formed by the combinations of glycine and valine, there are 4 meso compounds.

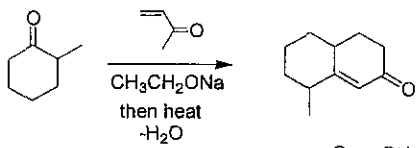
B. Amino acids can be prepared by the treatment of an aldehyde with NH_3 and CN^- and followed by hydrolysis.

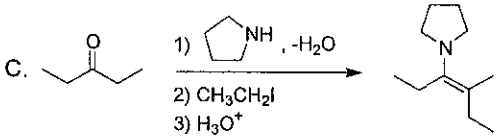
C. The alpha- and beta-anomers of glucose are a pair of enantiomer.

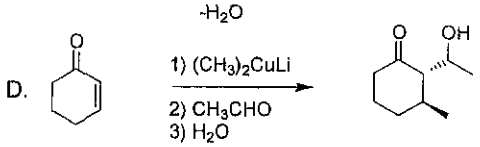
D. Alpha-anomer of glucose is more stable than beta-anomer in water.

15. Which of the following multi-step synthesis WILL give the indicated product?

A. 

B. 

C. 

D. 

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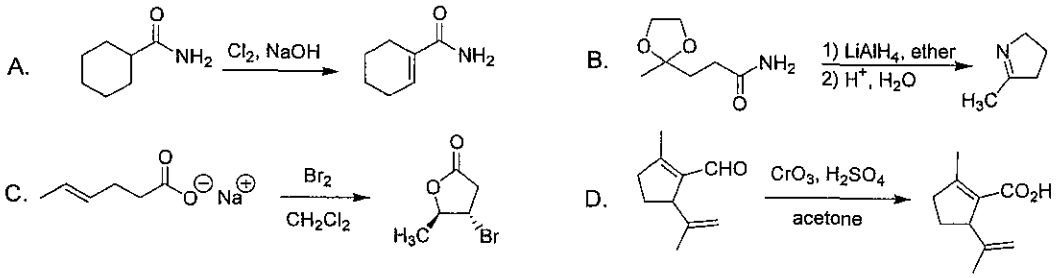
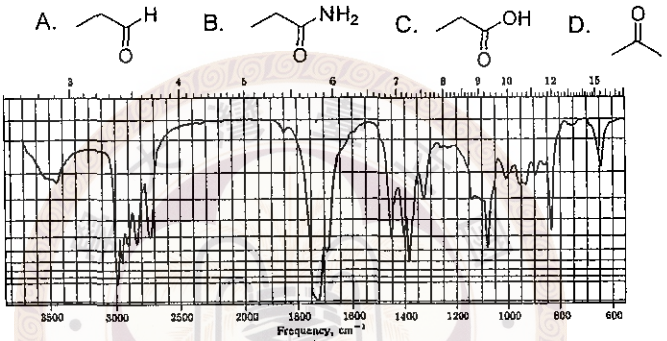
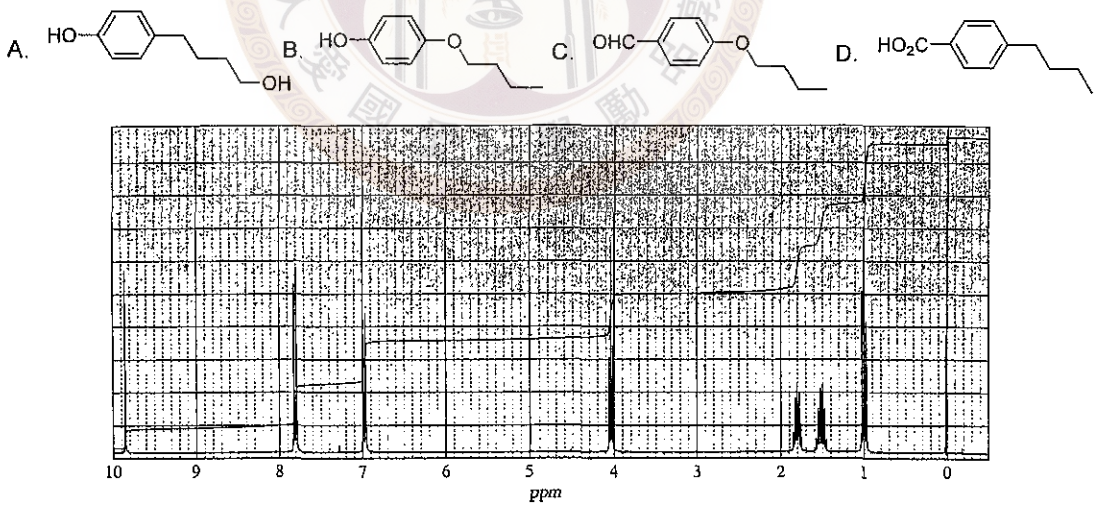
16. Which of the following multi-step synthesis WILL NOT give the indicated product?



17. The IR spectrum shown below is corresponding to which of the following compound?



18. The ^{1}H-NMR spectrum shown below is corresponding to which of the following compound?



二、問答題 (共 2 題，每題 7 分)

Provide suitable reagents (with less or equal to four carbons) for completing the following synthesis.

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無機化學 (50%) (選擇題答案請填入首頁選擇題答案區內)

I. Selection only one appropriate answer in each question (30%)

19. One of the compounds shown below is not stable under ambient conditions. Which is it?
(A) CCl_4 (B) $SiCl_4$ (C) $GeCl_4$ (D) $PbCl_2$ (E) $SiCl_2$

20. The structure of the hexaborane cluster B_6H_{10} is…
(A) octahedral
(B) pentagonal bipyramid with 1 missing vertex
(C) dodecahedron with 2 missing vertices
(D) tricapped trigonal prism with 3 missing vertices
(E) trigonal bipyramid

21. For the $[Mn(OH_2)_6]_2^+$ complex, the ligand field stabilization energy (LFSE) is:
(A) 0 Dq (B) 2 Dq (C) 4 Dq (D) 6 Dq (E) 8 Dq

22. Use the data below to calculate the lattice energy (kJ/mol) for $MgCl_2$.
H_{atm} Mg(s) = 147.7 kJ/mol; H_{ion} Mg(g) = 737.7 kJ/mol
H_{ion} Mg^+ (g) = 1450.6 kJ/mol; H_{diss} Cl_2(g) = 243.4 kJ/mol
H_{EA} Cl(g) = -348.7 kJ/mol; H_f $MgCl_2$(s) = -644 kJ/mol
(A) -1278 (B) -1439 (C) -2324 (D) -2264 (E) - 2526

23. Which one of the following complexes can most likely be able to isolate?
(A) $W_2(CO)_{10}$, (B) $[W_2(CO)_{10}]^-$ (C) $[W_2(CO)_{10}]^{2-}$ (D) $[W_2(CO)_{10}]^+$ (E) $[W_2(CO)_{10}]^{2+}$

24. Which of the following order is correct for the proton affinities?
(A) $N^{3-} > S^{2-} > O^{2-} > OH^- > NR_3 > NH_3 > NCl_3 > NF_3$
(B) $N^{3-} > S^{2-} > O^{2-} > OH^- > NR_3 > NH_3 > NF_3 > NCl_3$
(C) $N^{3-} > O^{2-} > S^{2-} > OH^- > NR_3 > NH_3 > NF_3 > NCl_3$
(D) $N^{3-} > O^{2-} > S^{2-} > OH^- > NR_3 > NH_3 > NCl_3 > NF_3$
(E) $N^{3-} > S^{2-} > O^{2-} > OH^- > NH_3 > NR_3 > NCl_3 > NF_3$

25. The magnetic moment (BM) of $[FeCl_4]^-$ is:
(A) 5.92 (B) 6.18 (C) 7.24 (D) 8.52 (E) 9.64

26. Which of the following polarizing power is correct?
(A) $K^+ > Ag^+$ (B) $K^+ > Li^+$ (C) $Li^+ > Be^{2+}$ (D) $Cu^{2+} > Ca^{2+}$ (E) $Ti^{2+} > Ti^{4+}$

27. How many peaks will be observed in ^{19}F NMR spectra of a solution of PCl_2F_3 in isopentane at -22 °C?
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

28. Using the "Slater's rules, Z* of Co (Z = 27) is:
(A) 2.4 (B) 3.9 (C) 4.7 (D) 5.6 (E) 6.1

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II. Answer the questions (20%)

1. (A) Construct a molecular orbital diagram for PF_5. For the sake of simplicity, ignore any π interactions between the phosphorus atom and the fluorine substituents and consider σ bonding only. (5%)
   (B) Based on the above molecular orbital diagram, write down the bond order and magnetism of PF_5. (5%)

2. Determine the number and symmetry designations of the infrared-active C-O stretching modes in the $Mo(CO)_5PR_3$ compound with the C_{4v} symmetry. (10%)

C_{4v}	E	$2C_4$ (z)	C_2	$2\sigma_v$	$2\sigma_d$	linear functions, rotations	quadratic functions	cubic functions
A_1	+1	+1	+1	+1	+1	z	x^2+y^2, z^2	z^3, $z(x^2+y^2)$
A_2	+1	+1	+1	-1	-1	R_z	-	-
B_1	+1	-1	+1	+1	-1	-	x^2-y^2	$z(x^2-y^2)$
B_2	+1	-1	+1	-1	+1	-	xy	xyz
E	+2	0	-2	0	0	(x, y) (R_x, R_y)	(xz, yz)	(xz^2, yz^2) (xy^2, x^2y) (x^3, y^3)

試題隨卷繳回