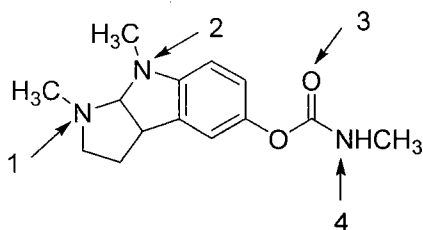
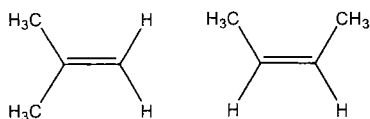


一、選擇題 (單選，每題 2 分，沒有倒扣，總共 80 分，請將答案填於答案卡)

- Which of the following amines is the most basic?  
 (A) aniline  
 (B) *N*-methylaniline  
 (C) *N,N*-dimethylaniline  
 (D) piperidine  
 (E) pyrrole
- Physostigmine is used in the treatment of glaucoma. Within this structure, the atom indicated by \_\_\_\_\_ is most basic, while atom \_\_\_\_\_ is least basic.



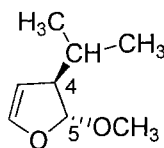
- 1 (most basic), 4 (least basic)  
 (B) 1 (most basic), 3 (least basic)  
 (C) 2 (most basic), 4 (least basic)  
 (D) 2 (most basic), 3 (least basic)  
 (E) None of the above.
- Which of the following reactive intermediates can best be described as both a nucleophile and a electrophile?  
 (A) Carbanions  
 (B) Carbocations  
 (C) Carbenes  
 (D) Free radicals  
 (E) Alkanes.
  - Are the compounds shown below best described as?



- Cis-trans isomers  
 (B) Constitutional isomers  
 (C) Not isomers  
 (D) Geometrical isomers  
 (E) None of the above.
- Which of the following reagents can be used to prepare epoxide from alkenes?  
 (A) Formic acid in water  
 (B) Peroxyformic acid in water  
 (C) *m*CPBA in methylene chloride  
 (D) Peroxybenzoic acid in sodium hydroxide  
 (E) Peroxyacetic acid in water

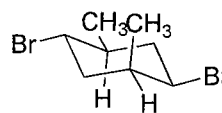
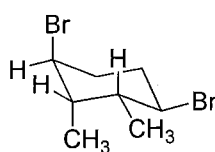
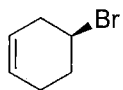
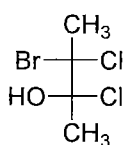
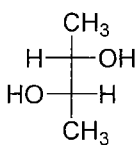
注意:背面有試題

6). Which of the following configurations corresponds to the structure below?



- (A) (4*E*, 5*Z*)  
 (B) (4*S*, 5*R*)  
 (C) (4*S*, 5*S*)  
 (D) (4*R*, 5*S*)  
 (E) (4*R*, 5*R*).

7). Which of the following compounds is meso?



- (A) (B) (C) (D) (E)

8). Rank each of the following compounds in order of increasing heat of hydrogenation. 1,2-hexadiene (A), 2-hexyne (B), *trans*-1,4-hexadiene (C), 1,5-hexadiene (D), and *trans*-2,4-hexadiene (E).

- (A)  $E < C < D < B < A$   
 (B)  $E < D < C < B < A$   
 (C)  $E < B < C < D < A$   
 (D)  $C < B < E < A < D$   
 (E)  $D < B < E < A < C$

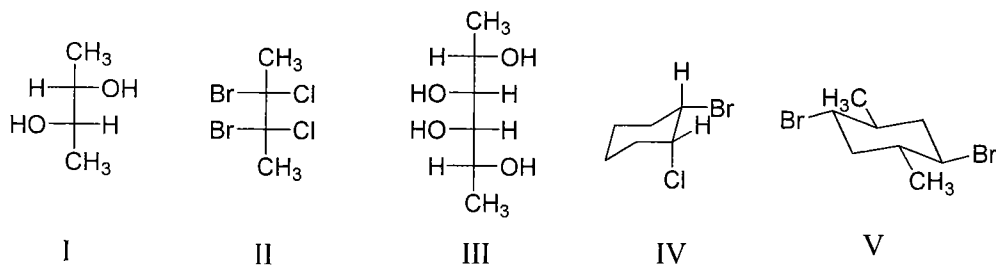
9). For same or similar molecular weight of following compounds, which one has the highest boiling point?

- (A) acids  
 (B) alcohols  
 (C) esters  
 (D) 1°-amides  
 (E) nitriles.

10). The acetoacetic ester synthesis is used to prepare?

- (A) alkylated acetic acid  
 (B) substituted acetone  
 (C) acetoacetic acid  
 (D) malonic ester  
 (E) none of the above.

11). Which of the following compounds are chiral?



- (A) I only  
 (B) II and III  
 (C) III and IV  
 (D) V only  
 (E) I and IV.

12). Which of the following solvents could be described as polar protic? (I) ethanol, (II) acetonitrile, (III) dimethylformamide, (IV) THF, and (V) diethyl ether.

- (A) I only  
 (B) II and III  
 (C) III only  
 (D) I and III  
 (E) III and V.

13). Rank the following species in order of decreasing acid-dissociation constant ( $K_a$ ): methanol (I), ethanol (II), 2-chloroethanol (III), *t*-butyl alcohol (IV), and phenol (V).

- (A) V > IV > III > II > I  
 (B) V > III > I > II > IV  
 (C) III > V > I > IV > II  
 (D) V > I > III > II > IV  
 (E) III > IV > V > II > I.

14). Which of the following statements about the heats of combustion of acetylene, ethene, and ethane is incorrect?

- (A) Acetylene is the best high-temperature flame.  
 (B) Ethene produced the most heat per mole of gas consumed.  
 (C) Acetylene produced the most heat per mole of products formed.  
 (D) The oxyacetylene flame reaches temperatures as high as 2800 °C.  
 (E) Acetylene release the most heat per mole of gas consumed.

15). Which of the following statements about Lucas test is correct?

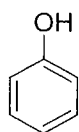
- (A) The reagent composed of HCl and ZnI<sub>2</sub>  
 (B) Tertiary alcohols react faster than primary alcohol  
 (C) Primary alcohols react by the S<sub>N</sub>1 mechanism  
 (D) Primary alcohols react faster than tertiary alcohols.  
 (E) Tertiary alcohols react by the S<sub>N</sub>2 mechanism.

注意:背面有試題

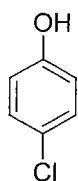
- 16). Which of the species below is/are more basic than acetylide?  
 (I)  $\text{CH}_3\text{Li}$ , (II)  $\text{CH}_3\text{ONa}$ , (III)  $\text{CH}_3\text{MgBr}$ , (IV)  $\text{NaOH}$ , (V)  $\text{KOH}$ .

- (A) I only  
 (B) II only  
 (C) III only  
 (D) I and III  
 (E) II and IV.

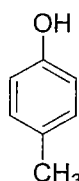
- 17). Arrange the following compounds in order of increasing acidity (*i.e.*, **least acidic first**).



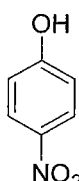
I



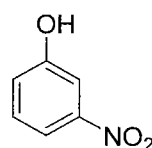
II



III



IV



V

- (A) III, I, II, V, IV  
 (B) I, II, III, IV, V  
 (C) V, IV, III, II, I  
 (D) V, IV, II, I, III  
 (E) I, IV, II, III, V

- 18). Which of the following compound(s) would be expected to show a sharp and strong IR absorption peak at  $3300\text{ cm}^{-1}$ ?

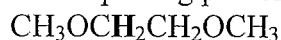
(I)  $\text{CH}_3\text{C} \equiv \text{CCH}_3$ , (II) butane, (III) but-1-ene, (IV)  $\text{CH}_3\text{CH}_2\text{C} \equiv \text{CH}$ , (V) butan-1-ol

- (A) I and III  
 (B) III only  
 (C) IV only  
 (D) IV and V  
 (E) I, IV, and V.

- 19). Which of the following acid derivatives has the highest IR stretching frequency for carbonyl group?

- (A)  $\gamma$ -butyrolactone  
 (B)  $\beta$ -propiolactam  
 (C)  $\delta$ -valerolactone  
 (D)  $\gamma$ -butyrolactam  
 (E) nitrile.

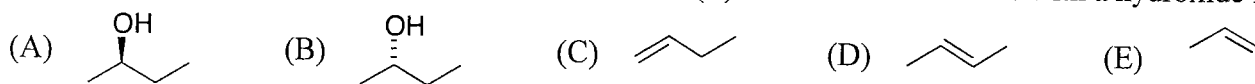
- 20). What splitting pattern is observed in the proton NMR spectrum for the underlined hydrogens?



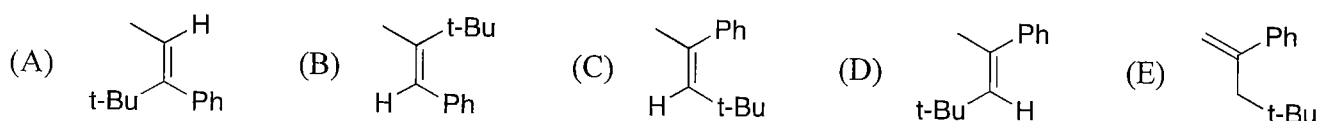
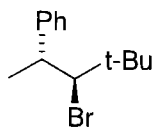
- (A) Singlet  
 (B) Doublet  
 (C) Triplet  
 (D) Quartet  
 (E) Septet.

注意：背面有試題

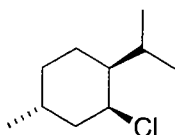
21). Please identify the  $S_N2$  product that is obtained when (*R*)-2-bromobutane reacts with a hydroxide ion.



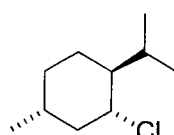
22). Please identify the major E2 elimination product of the following compound.



23). Which of the following compounds is less reactive toward an E2 process? And if it reacts, what is the structure of its E2 product?

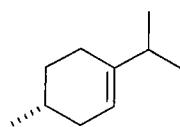


neomenthyl chloride

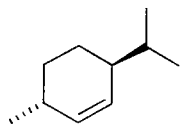


menthyl chloride

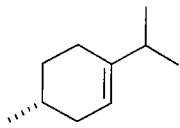
(A) neomenthyl chloride;



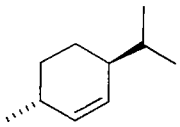
(B) neomenthyl chloride;



(C) menthyl chloride;

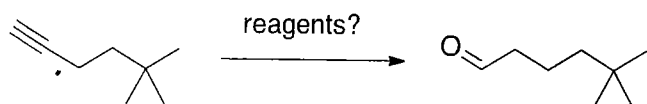


(D) menthyl chloride;



(E) Both compounds cannot undergo an E2 reaction.

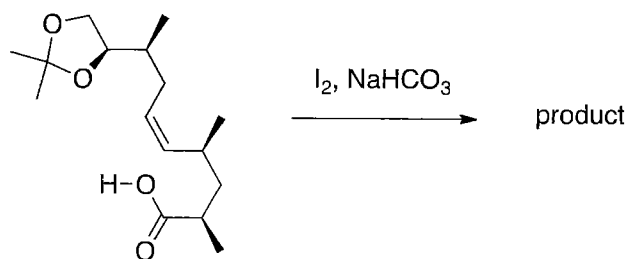
24). Identify reagents that you could use to achieve the following transformation.



- (A) Na,  $\text{NH}_3$ ;  $\text{H}_2\text{O}$  (B)  $\text{NaNH}_2$ ;  $\text{H}_2\text{O}$  (C)  $\text{F}_3\text{CCO}_2\text{H}$  (D)  $\text{O}_3$ ;  $\text{H}_2\text{O}$   
 (E) disiamylborane;  $\text{H}_2\text{O}_2$ , NaOH

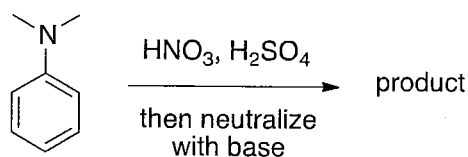
注意:背面有試題

- 25). The following reaction produces one major product via an iodolactonization. Sodium bicarbonate acts as a mild base to deprotonate the carboxylic acid group. Identify the major product of this reaction.



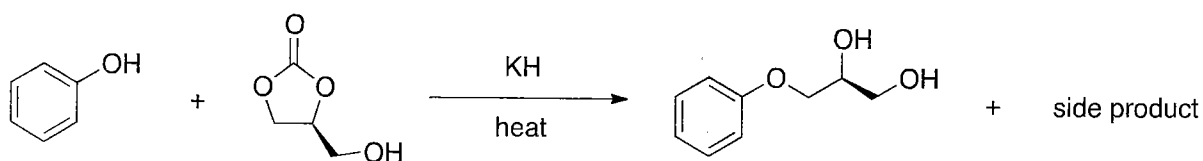
- (A)
- (B)
- (C)
- (D)
- (E)

- 26). Identify the major product of the following reaction.



- (A)
- (B)
- (C)
- (D)
- (E)

- 27). Indicate the side product of the following transformation.



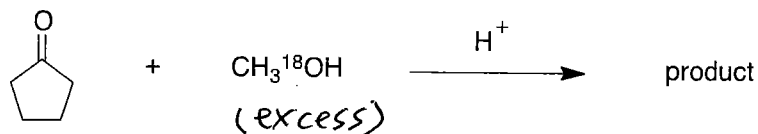
- (A) CO (B) CO<sub>2</sub> (C) CO<sub>3</sub><sup>2-</sup> (D) CH<sub>3</sub>OH (E) H<sub>2</sub>O

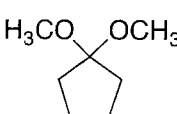
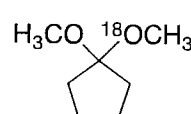
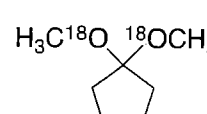
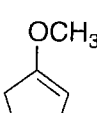
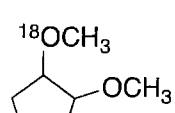
注意:背面有試題

28). Which naturally occurring amino acid is achiral?

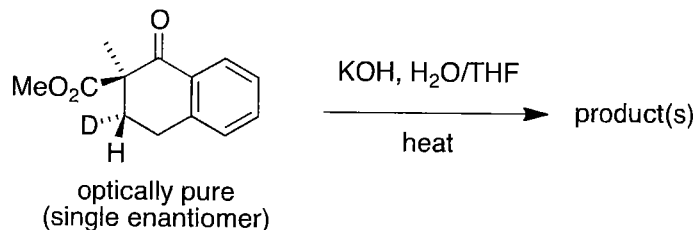
- (A) glycine (B) alanine (C) proline (D) leucine (E) serine

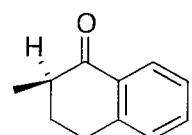
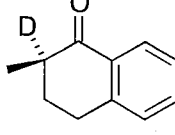
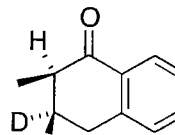
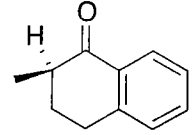
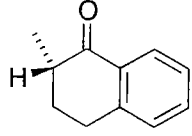
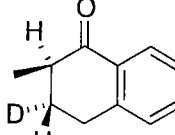
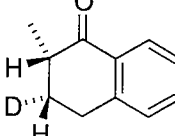
29). Identify the major product of the following reaction.



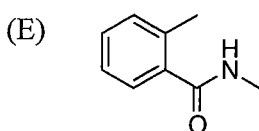
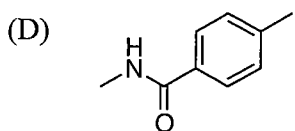
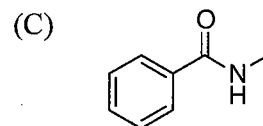
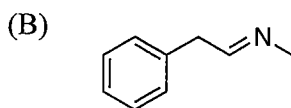
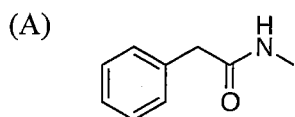
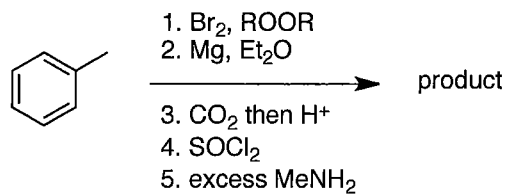
- (A)  (B)  (C) 
- (D)  (E) 

30). Identify the major product of the following reaction.

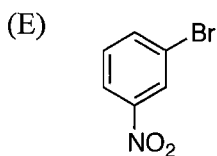
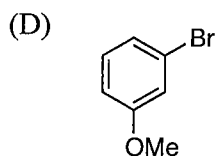
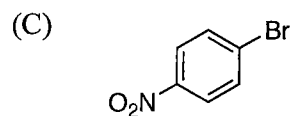
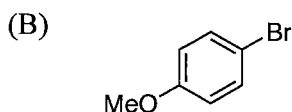
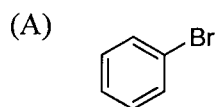


- (A)  (B)  (C) 
- (D)  and 
- (E)  and 

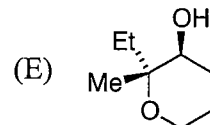
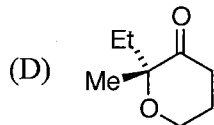
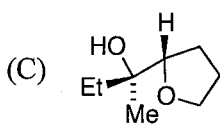
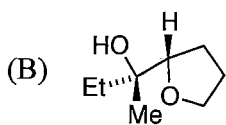
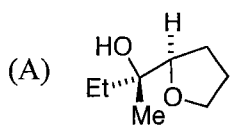
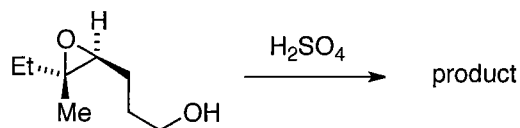
31). What is the final product of this sequence of reactions?



32). Which compound reacts most rapidly with  $\text{CH}_3\text{ONa}$ ?

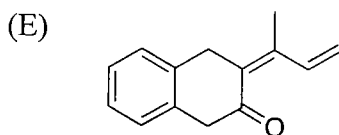
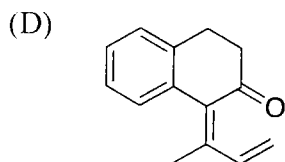
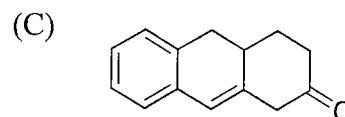
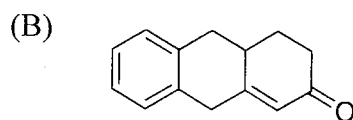
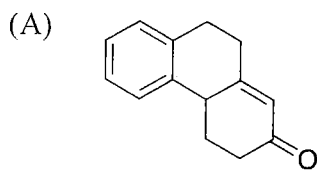
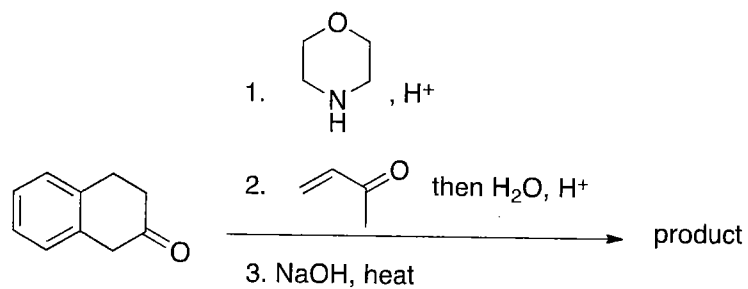


33). Identify the major product of the following reaction.

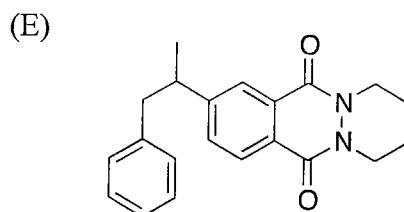
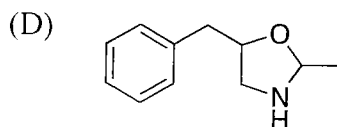
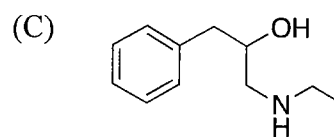
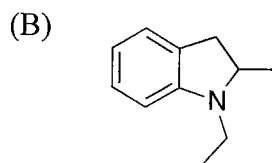
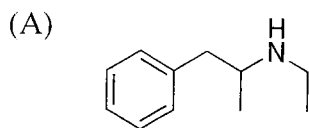
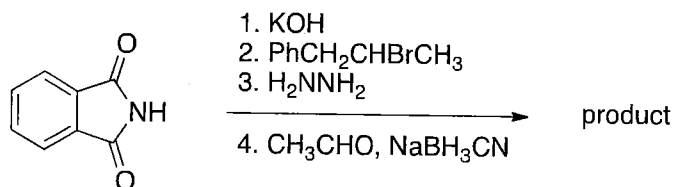




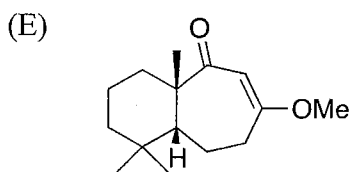
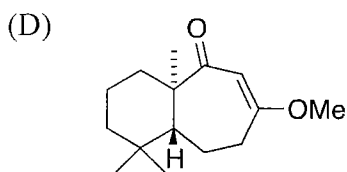
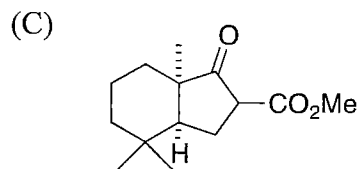
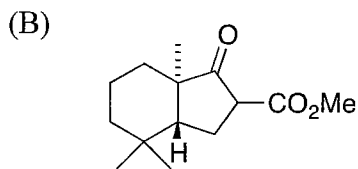
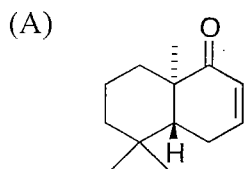
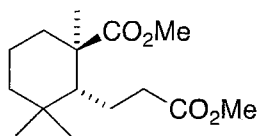
34). What is the final product of the following reaction sequence?



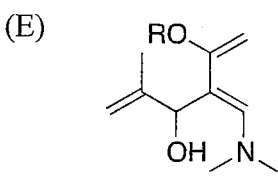
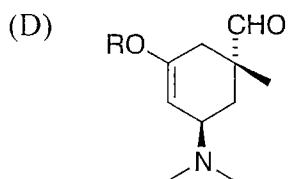
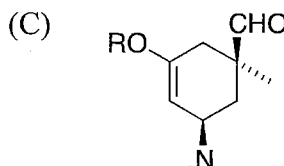
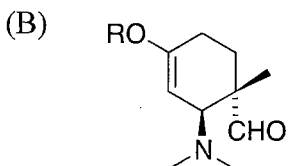
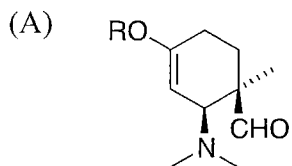
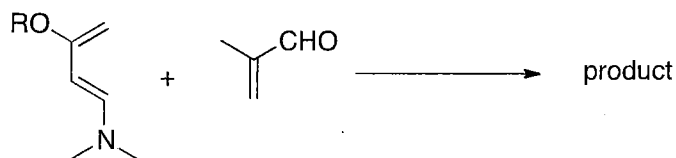
35). What is the final product of this sequence of reactions?



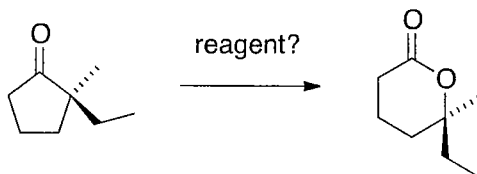
36). Identify the product of the Dieckmann condensation of the diester.



37). Identify the major product of the following reaction.



38). Identify a reagent that you could use to achieve the following transformation.



(A)  $\text{MnO}_2$

(B)  $\text{RCO}_3\text{H}$

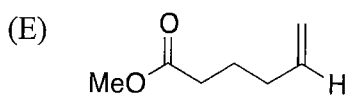
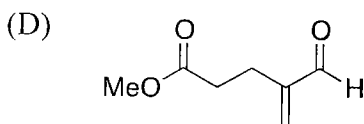
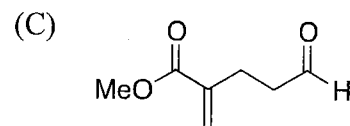
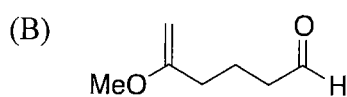
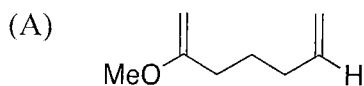
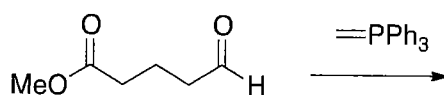
(C)  $\text{H}_2\text{O}$

(D)  $\text{KOH}$

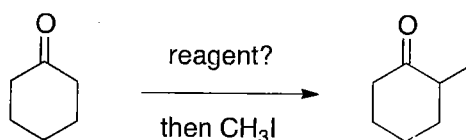
(E)  $\text{Pd}(\text{OAc})_2$

注意:背面有試題

39). Identify the major product of the following reaction.



40). Identify reagent(s) that you could use most effectively to achieve the transformation.



(A)  $K_2CO_3$

(B) LDA

(C) pyridine

(D)  $CH_3Li$

(E)  $CH_3OTs$

二、多選題 (每題 2 分，總共 20 分，請將答案填於答案卡；每小題有 5 個選項，其中至少有 2 個是正確答案。各小題之選項獨立判定，每一選項答對者得 0.4 分，答錯者倒扣 0.4 分，倒扣至此大題 (即多選題) 0 分為止)

41). In the reaction of 1,3-butadiene with HBr if the reagents are allowed to react at  $40^\circ C$ , what would be the predominant product formed?

- A) thermodynamic product
- B) kinetic product
- C) 4-bromo-1-butene
- D) 3-bromo-1-butene
- E) 1,4-addition product.

42). In the nitration of a 1:1 mixture of benzene and toluene, which of the following statements are correct?

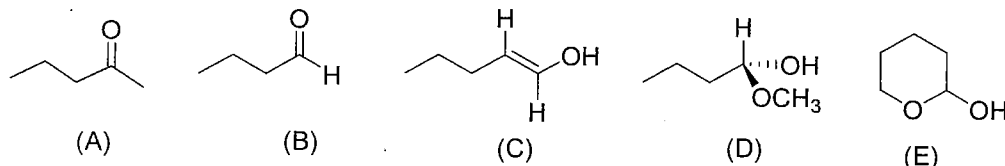
- (A) nitrobenzene will be the major product
- (B) more *meta*- than *ortho*-nitrotoluene is formed
- (C) *ortho*- and *para*-nitrotoluenes are the major products
- (D) dinitrobenzene is formed
- (E) more *ortho*-nitrotoluene than nitrobenzene is formed.

43). In the formylation of benzene what reagents are needed:

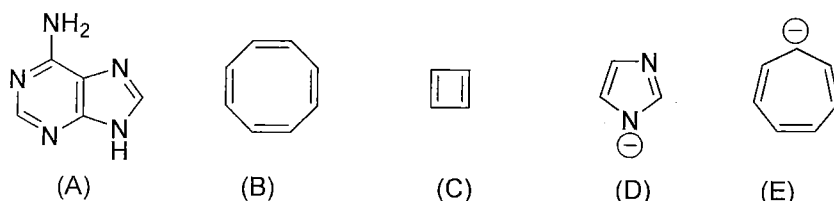
- (A)  $HCOCl$
- (B)  $CO/HCl$
- (C)  $AlCl_3/CuCl$
- (D)  $CH_3COCl, AlCl_3$
- (E) all of the above.

注意:背面有試題

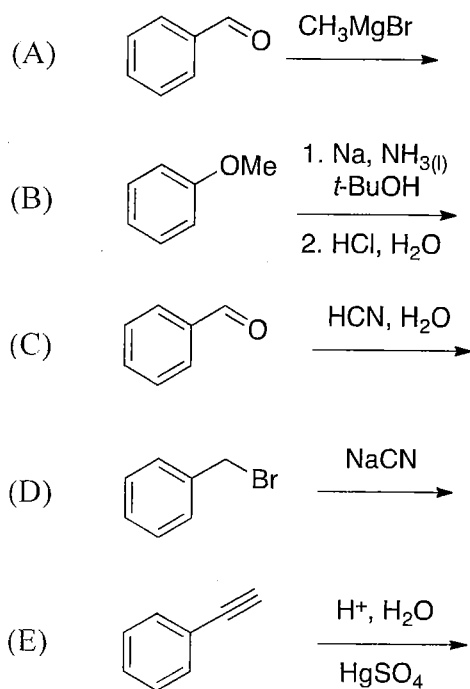
44). Which of the following compounds would give a positive Tollen test? Remember that the Tollen test involves mild basic aqueous conditions.



45). Which of the following molecules are aromatic compounds?



46). Which of the following reactions will give a ketone as a major product?



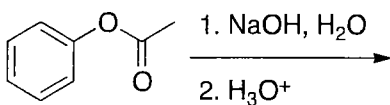
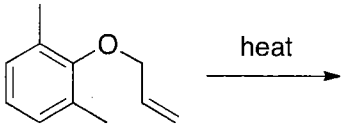
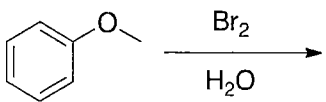
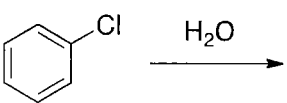
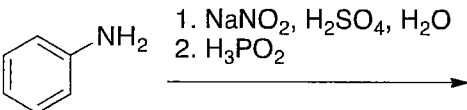
47). When the name of a monosaccharide is preceded only by (+), it can be said, correctly, that:

- (A) The compound is the  $\alpha$ -anomer.
- (B) The compound exists in the pyranose form.
- (C) The compound is dextrorotatory.
- (D) The compound is made from D-(+)-glucose.
- (E) The compound is chiral.

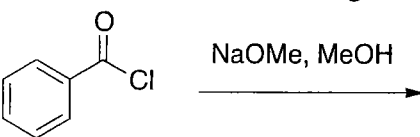
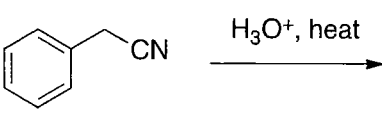
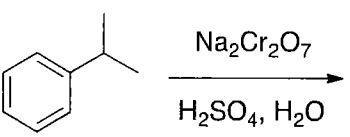
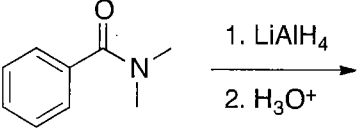
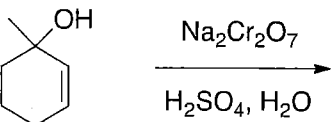
48). Which attractive force is responsible for maintaining the tertiary structure of a protein?

- (A) Disulfide linkages
- (B) Hydrogen bonds
- (C) Hydrophobic interactions
- (D) van der Waals forces
- (E) None of these choices.

49). Which of these reactions will give a phenol as a major product?

- (A)   $\xrightarrow[2. \text{H}_3\text{O}^+]{1. \text{NaOH}, \text{H}_2\text{O}}$
- (B)   $\xrightarrow{\text{heat}}$
- (C)   $\xrightarrow[\text{H}_2\text{O}]{\text{Br}_2}$
- (D)   $\xrightarrow{\text{H}_2\text{O}}$
- (E)   $\xrightarrow[2. \text{H}_3\text{PO}_2]{1. \text{NaNO}_2, \text{H}_2\text{SO}_4, \text{H}_2\text{O}}$

50). Which of these reactions will give a carboxylic acid as a major product?

- (A)   $\xrightarrow{\text{NaOMe}, \text{MeOH}}$
- (B)   $\xrightarrow[\text{heat}]{\text{H}_3\text{O}^+}$
- (C)   $\xrightarrow[\text{H}_2\text{SO}_4, \text{H}_2\text{O}]{\text{Na}_2\text{Cr}_2\text{O}_7}$
- (D)   $\xrightarrow[2. \text{H}_3\text{O}^+]{1. \text{LiAlH}_4}$
- (E)   $\xrightarrow[\text{H}_2\text{SO}_4, \text{H}_2\text{O}]{\text{Na}_2\text{Cr}_2\text{O}_7}$