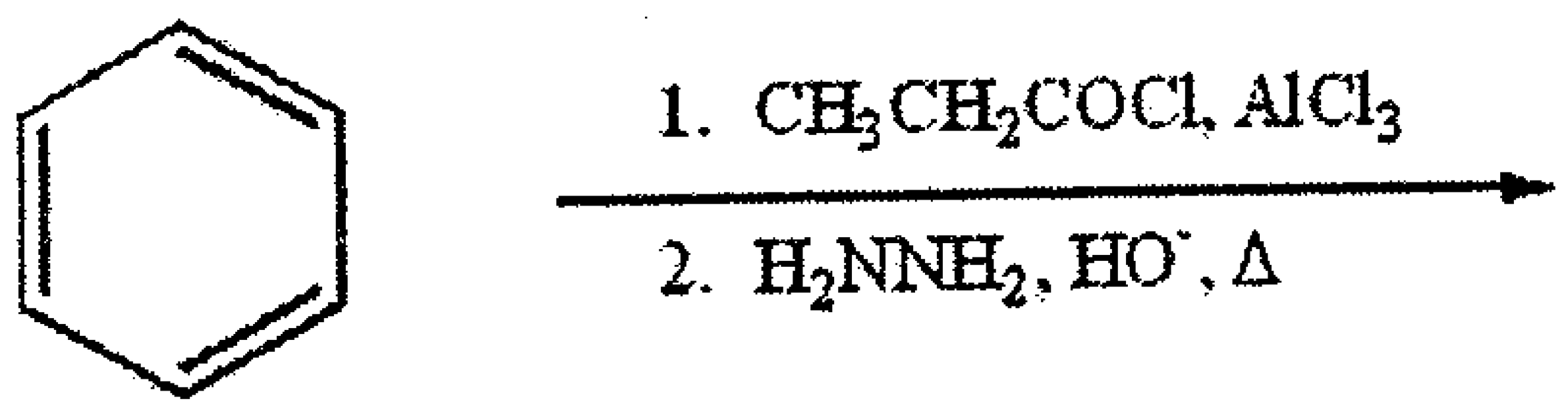
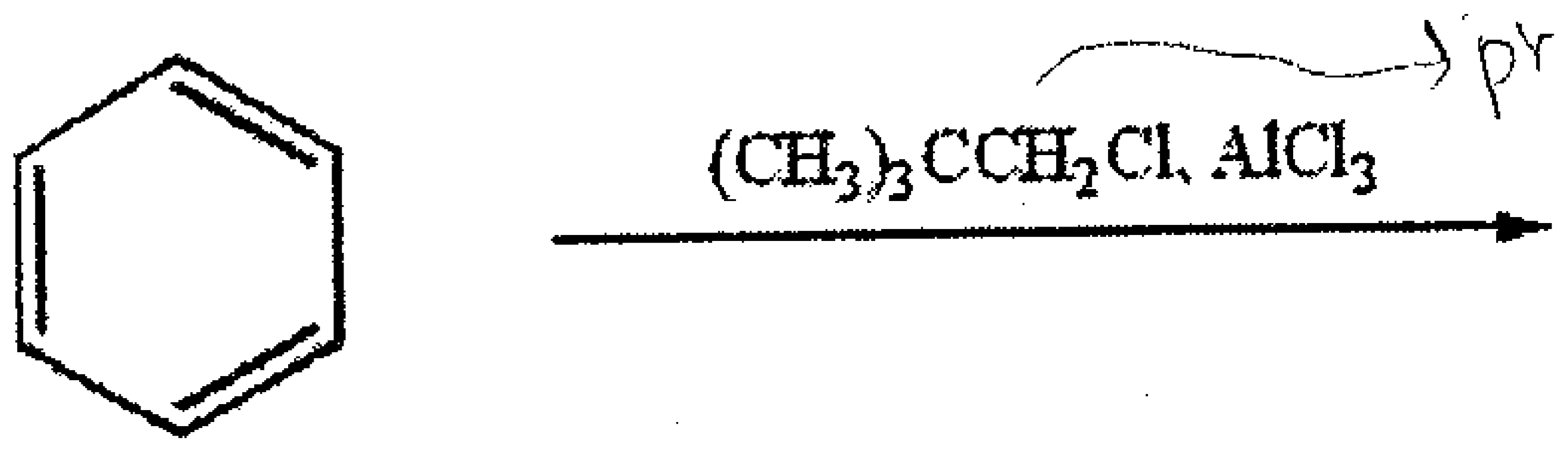
Test 2

E 1. Indicate the major product.



a. $PhC(=O)CH_2CH_3$ b. $PhCH_2CH_2Ph$ c. $PhC(=N\text{-}NH_2)CH_2CH_3$ d. $PhCH{=}C(NH\text{-}NH_2)CH_3$ e. $PhCH_2CH_2CH_3$

E 2. Indicate the major product.



a. $PhCH_2C(CH_3)_3$ b. $CH_3C(Ph)(CH_3)CH_2CH_3$ c. $(CH_3)_2CHCH(Ph)CH_3$ d. $(CH_3)_2CHCH_2CH_2Ph$

e. None of the above

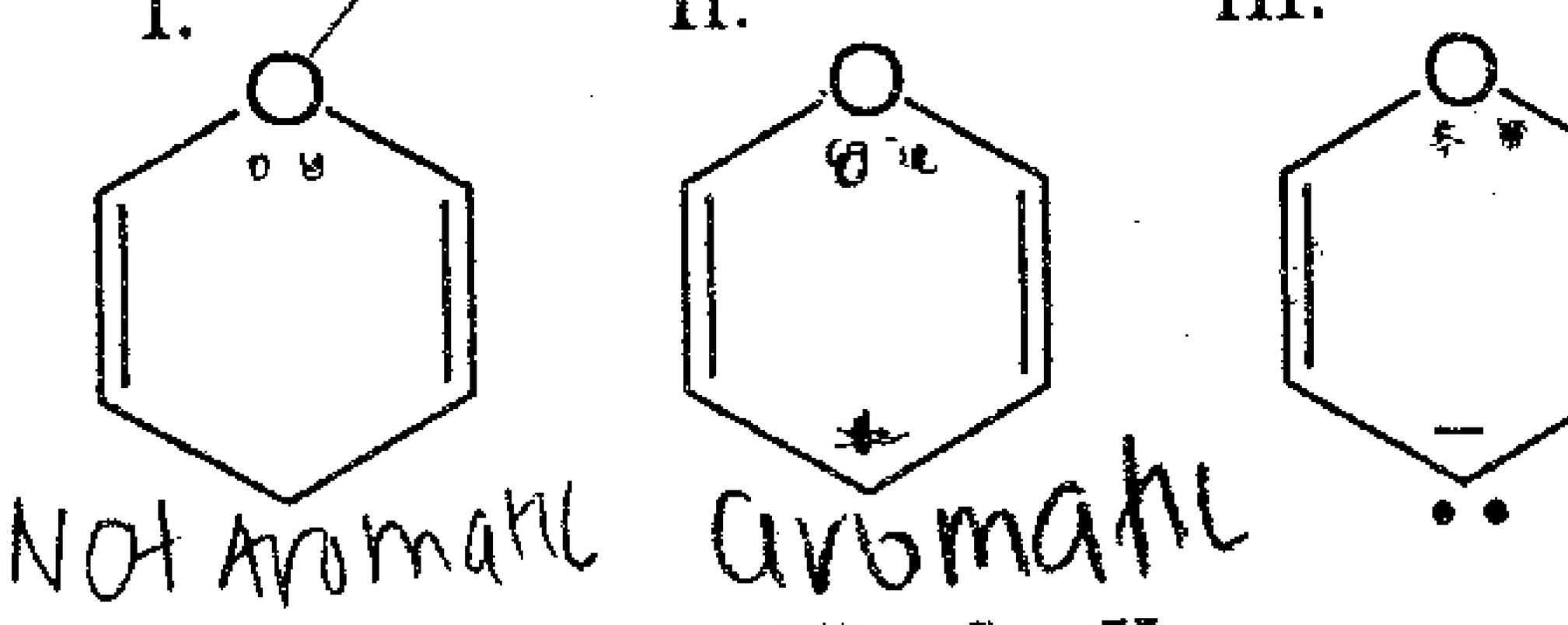
A 3. Which of the following statements about the π-molecular orbital description of ground-state cyclobutadiene is not correct?

a. Cyclobutadiene has two electrons in nonbonding π-molecular orbitals.
b. Cyclobutadiene has a single bonding π-molecular orbital
c. ~~Cyclobutadiene has one electron in an anti-bonding π-molecular orbital which makes it antiaromatic~~
d. Cyclobutadiene has two degenerate nonbonding π-molecular orbitals
e. Cyclobutadiene has no electrons in anti-bonding molecular orbitals.

2, 4, 8

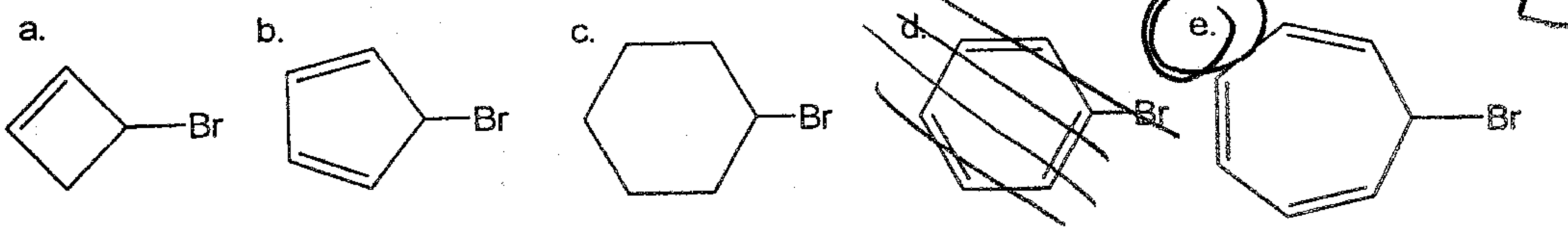
D 4. Rank the following molecules in order of decreasing stability, from most stable to least. Assume all structures are planar. Hint: Think of furan.

I. II. III.

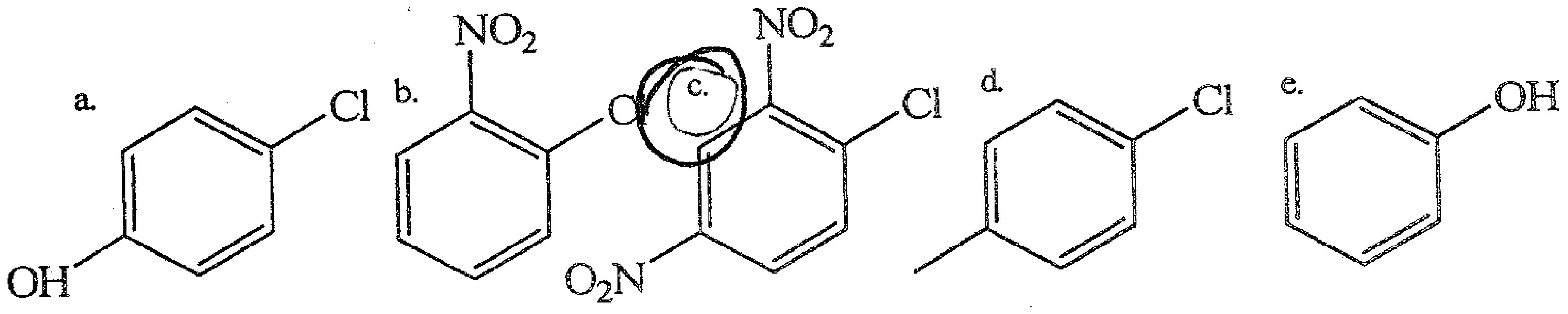


a. ~~I > II > III~~ b. II > III > I ~~c. III > I > II~~ d. II > I > III ~~e. I > III > II~~

A 5. Which of the following undergoes solvolysis (ie, S_N1 reaction) in methanol most rapidly?

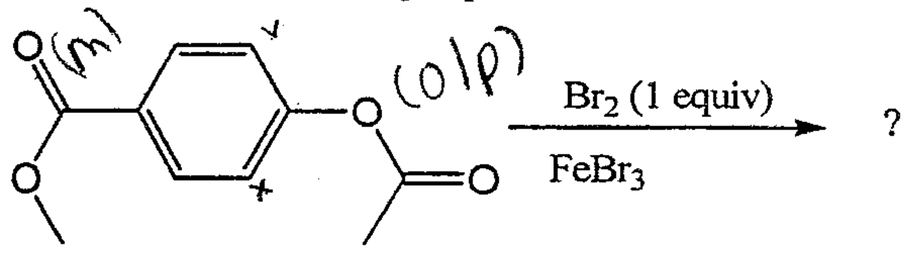


C 6. Which of the following is most reactive towards **nucleophilic** aromatic substitution?



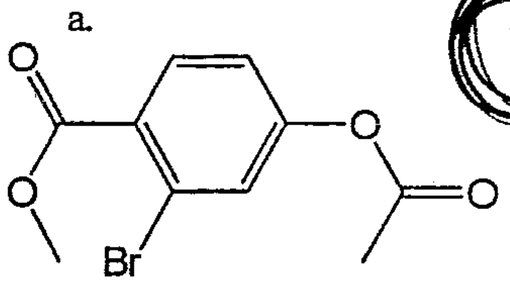
B

7. Indicate the major product.

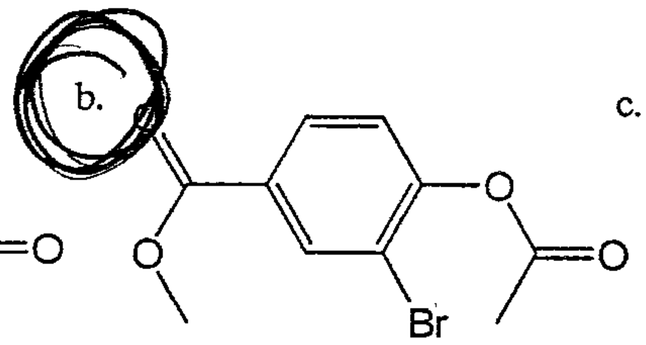


Br_2 (1 equiv), $FeBr_3$ → ?

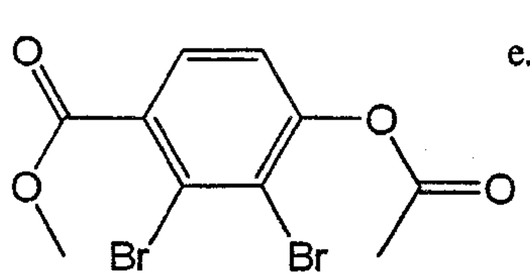
a.



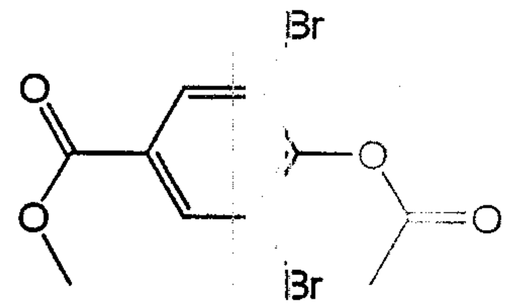
b.



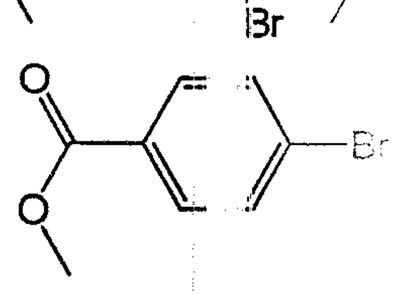
c.



d.



e.



E

8. Starting from benzene the best way to make *m*-propylbenzenesulfonic acid is:

~~A. 1. SO_3, H_2SO_4 2. $CH_3CH_2CH_2Cl$, $AlCl_3$~~ ~~B. 1. $CH_3CH_2CH_2Cl$, $AlCl_3$ 2. SO_3, H_2SO_4~~

~~C. 1. CH_3CH_2CCl, $AlCl_3$ 2. SO_3, H_2SO_4~~ ~~D. 1. CH_3CH_2CCl, $AlCl_3$ 2. Zn(Hg), HCl, Δ 3. SO_3, H_2SO_4~~

E. 1. CH_3CH_2CCl, $AlCl_3$ 2. SO_3, H_2SO_4 3. Zn(Hg), HCl, Δ

C

9. Starting from benzene the best way to make *m*-chloroaniline is:

~~A. 1. NH_3, $NaNH_2$ 2. $Cl_2/AlCl_3$~~ ~~B. 1. HNO_3/H_2SO_4 2. Sn/HCl 3. HO^- 4. Cl_2/Al~~

C. 1. HNO_3/H_2SO_4 2. $Cl_2/AlCl_3$ 3. Sn/HCl 4. HO^- D. 1. $Cl_2/AlCl_3$ 2. NH_3

E. 1. $Cl_2/AlCl_3$ 2. HNO_3/H_2SO_4 3. Sn/HCl 4. HO^-

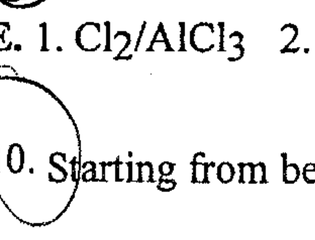
B

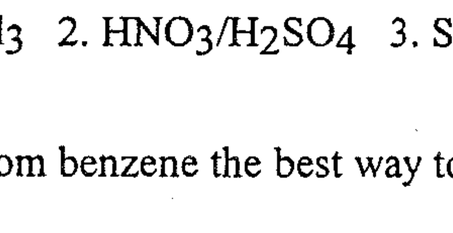
10. Starting from benzene the best way to make *m*-dibromobenzene is:

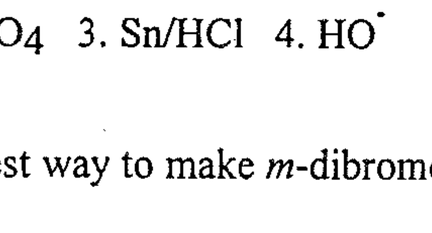
a. 1. H_2SO_4, HNO_3 2. Sn/HCl; $NaNO_2$/HCl, 0°C 3. H_3PO_2 4. $FeBr_3$, excess Br_2
b. 1. H_2SO_4, HNO_3 2. Sn/HCl; $NaNO_2$/HCl, 0°C 3. $FeBr_3$, excess Br_2 4. H_3PO_2
c. $FeBr_3$, excess Br_2
d. 1. H_2SO_4, HNO_3 2. Sn/HCl; $NaNO_2$/HCl, 0°C 3. $FeBr_3$, excess Br_2
e. 1. H_2SO_4, HNO_3 2. Sn/HCl; $NaNO_2$/HCl, 0°C 3. H_3PO_2 4. CuBr

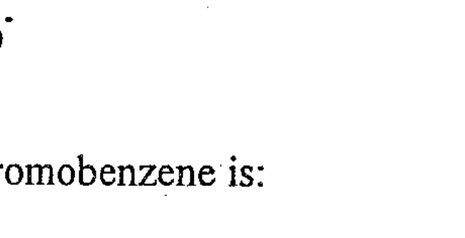
B

11. Rank the following compounds in expected order of decreasing basicity, from most basic to least.

I. 

II. 

III. 

IV. 

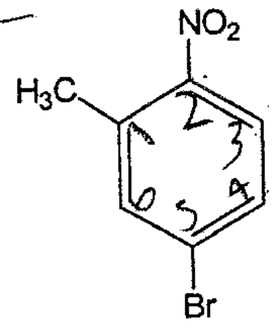
least basic

acid

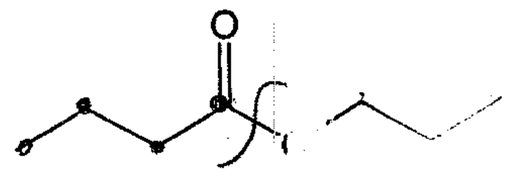
a. ~~I > II > IV > III~~ b. II > I > III > IV c. ~~III > IV > I > II~~ d. IV > I > II > IV e. ~~II > I > IV > I~~

Provide the IUPAC name for the following:

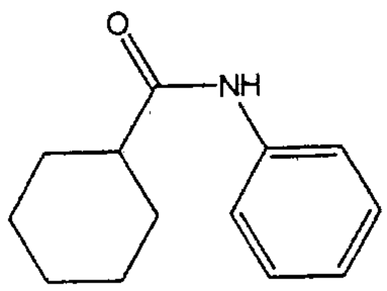
12.
~~a. 4-bromo-2-methyl-1-nitrobenzene~~
b. *m*-bromo-*o*-nitrotoluene
c. 3-bromo-2-nitrotoluene
d. 2-nitro-5-bromotoluene
e. 3-bromo-6-nitrotoluene



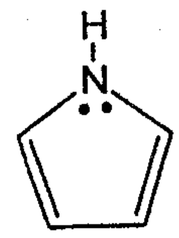
13.
a. 4-carboxoheptane
b. propyl butanoate
c. butyl butanoate
d. butyl propanoate
e. propyl propanoate



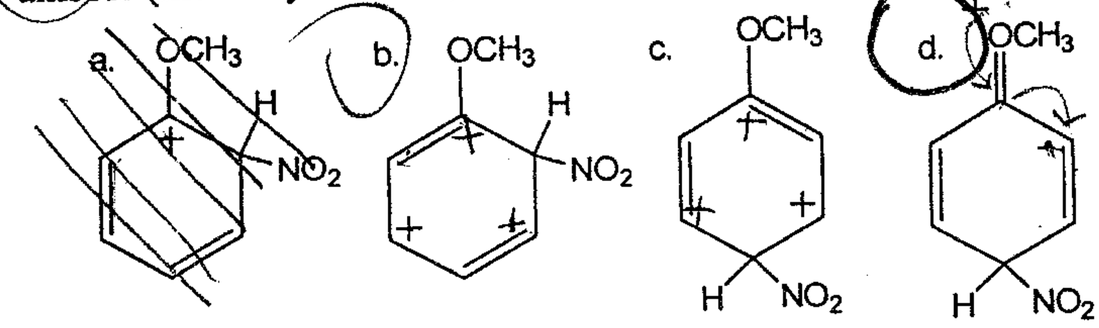
14.
a. cyclohexylbenzenecarboxamide
b. benzenecyclohexylcarboxamide
c. *N*-phenylcyclohexanecarboxamide
d. *N*-cyclohexylbenzenecarboxamide
e. *N*-benzylcyclohexanecarboxamide



15.
a. pyridine
b. pyrimidine
c. pyrrolidine
d. pyrrole
e. payrole

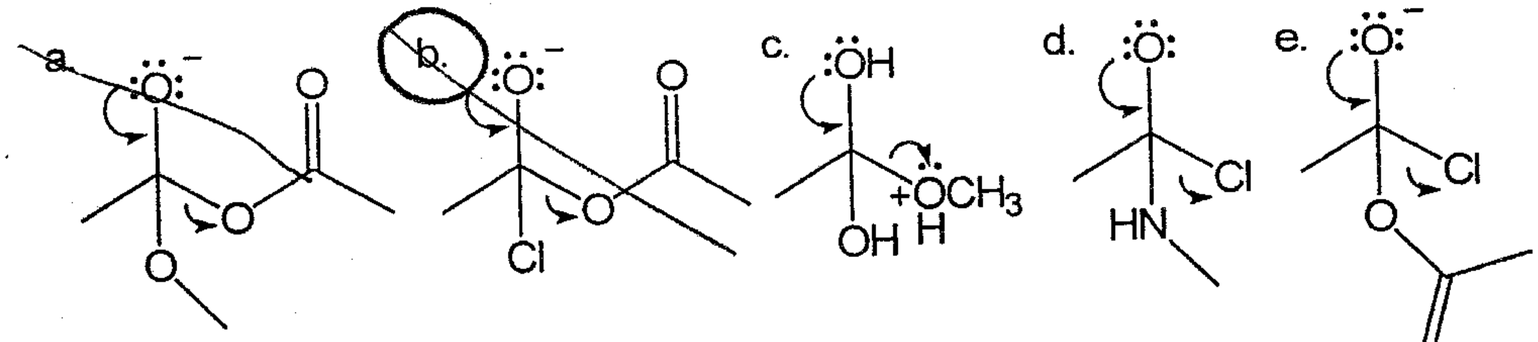


16. Which is not a resonance contributor of the intermediates formed in the major reaction pathways when anisole (methoxybenzene) undergoes nitration?

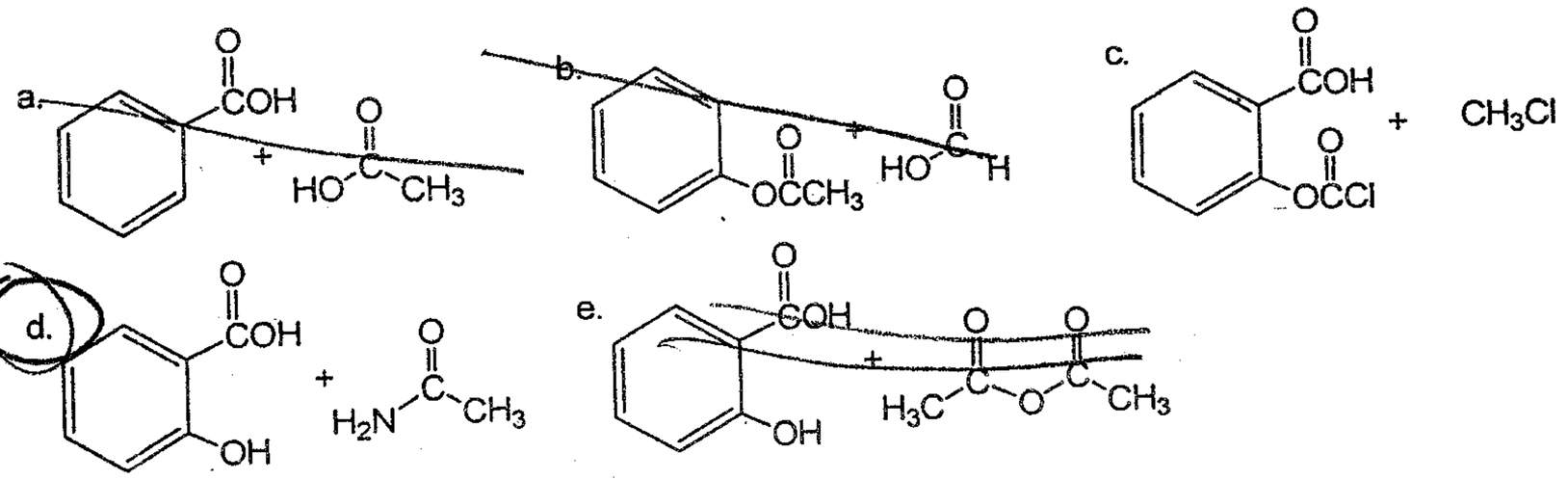


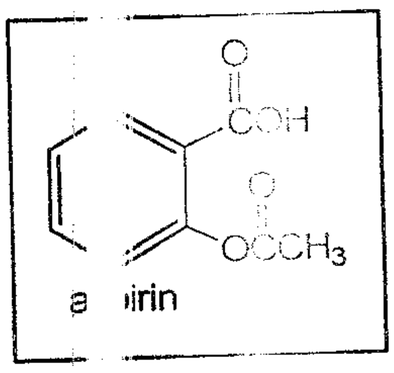
e. None of the above.
All are valid contributors.

17. Based on what we know about valid interconversions of carboxylic acid derivatives, which of the following would be an incorrect depiction of a mechanistic step?

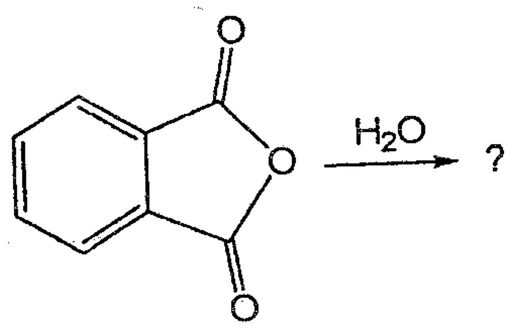


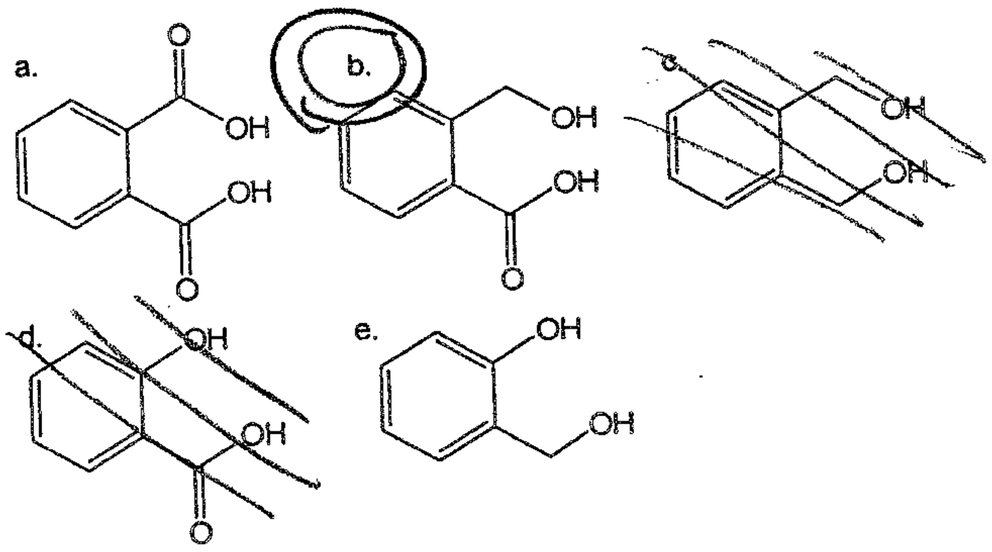
18. Which of the following is the best method of preparing aspirin?





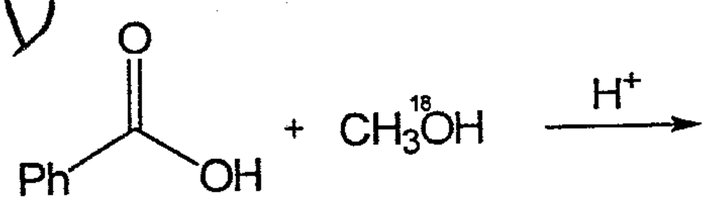
19.

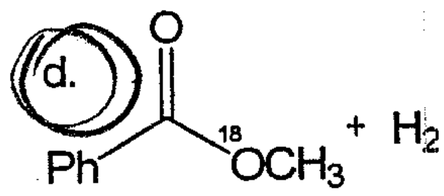


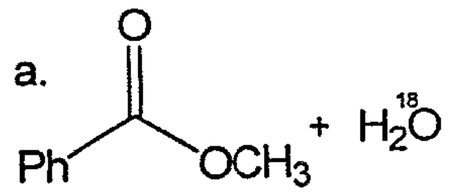


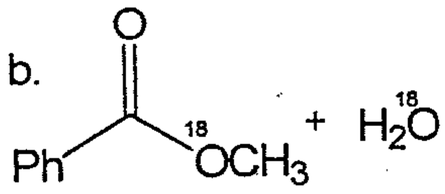
20. If you treat the product of the prior reaction with a large excess of lithium aluminum hydride followe by H_3O^+, what is the product? Use the same answer choices as provided in the prior question.

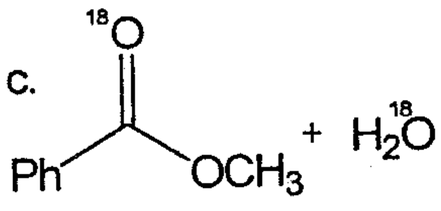
21. The following reaction produces which products?

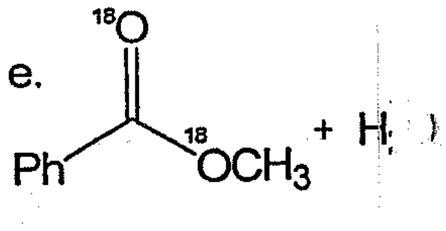




a. 

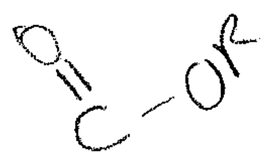
b. 

c. 

e. 

22. Which is a valid method of making methyl benzenecarboxylate (common name, methyl benzoate) fr benzene?

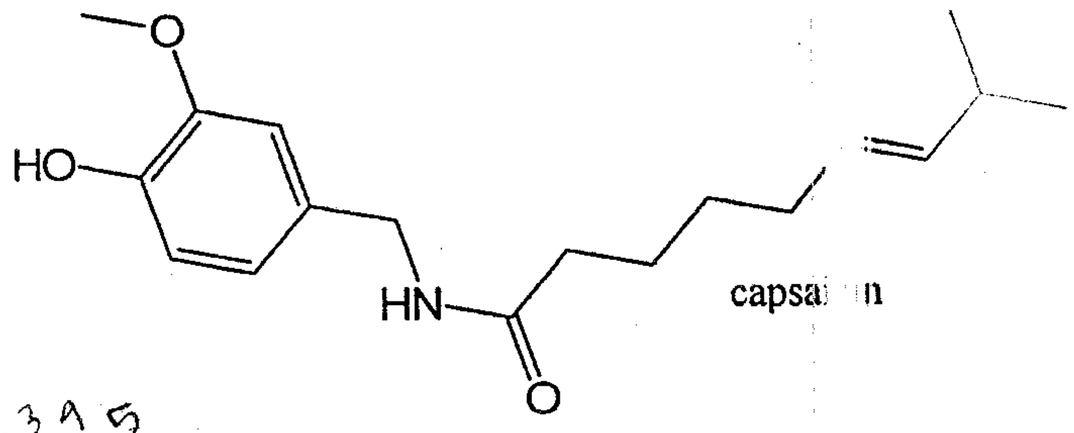
a. 1. CH_3Cl, $AlCl_3$ 2. $KMnO_4$, Δ 3. H^+ 4. $SOCl_2$ 5. CH_3OH
b. 1. Br_2, $FeBr_3$ 2. Mg, Et_2O 3. CO_2 4. H^+ 5. $SOCl_2$ 6. CH_3OH
c. 1. CH_3Cl, $AlCl_3$ 2. $Na_2Cr_2O_7$, Δ, H^+ 3. PCl_3 4. CH_3OH
d. 1. Br_2, $FeBr_3$ 2. Mg, Et_2O 3. CO_2 4. H^+, xs CH_3OH
e. All of the above



23. Capsaicin, a major component of hot peppers, contains which functional group(s)?

a. ester b. anhydride c. amide d. hemiacetal

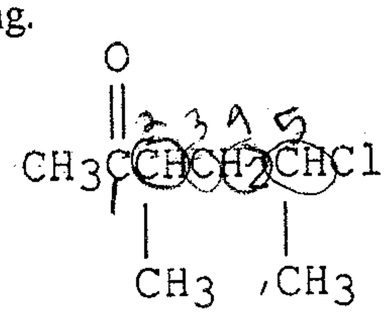
e. more than one of the above



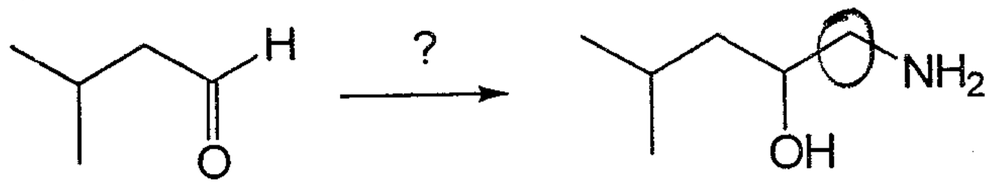
capsa n

24. Provide the IUPAC name for the following.

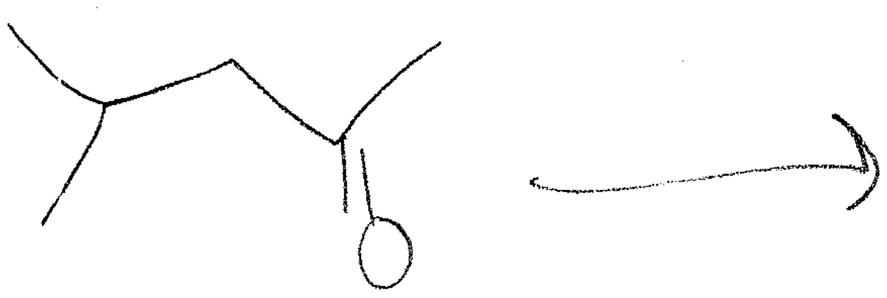
a. 5-chloro-3,5-dimethyl-2-pentanone
b. 5-chloro-3-methylhexanone
c. 2-chloro-4-methyl-5-hexanone
d. 1-chloro-1,3-dimethyl-4-pentanone
e. 5-chloro-3-methyl-2-hexanone



25. Which is the best method for the following transformation?

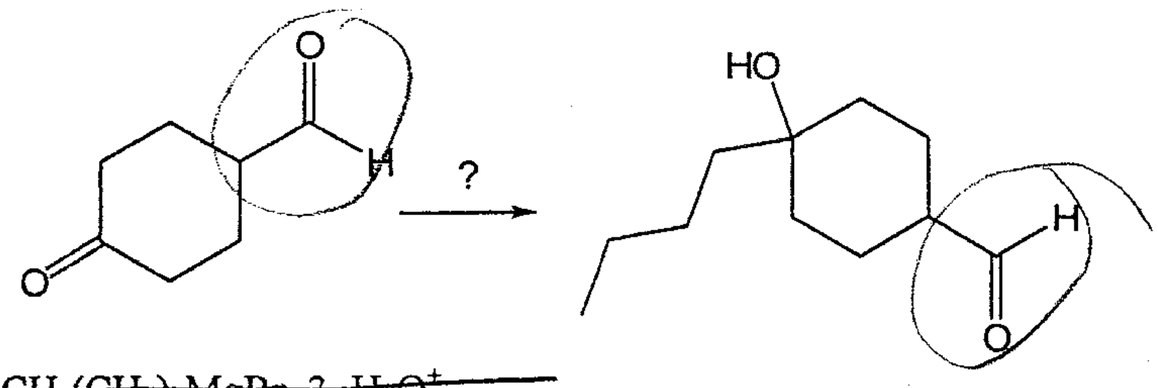


a. 1. NaCN, HCl 2. H_2, Pt
b. 1. H_2NNH_2, H^+ 2. CH_2Cl_2 3. H_3O^+
c. 1. Prepare reagent X by adding H_2NCH_2Br to Mg in ether. 2. Add X to starting material above 3. H_3
d. 1. NH_3, H^+ 2. H_2, Pt
e. None of the above are valid syntheses



D

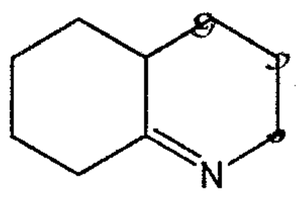
26. Which is the best method for the following transformation?



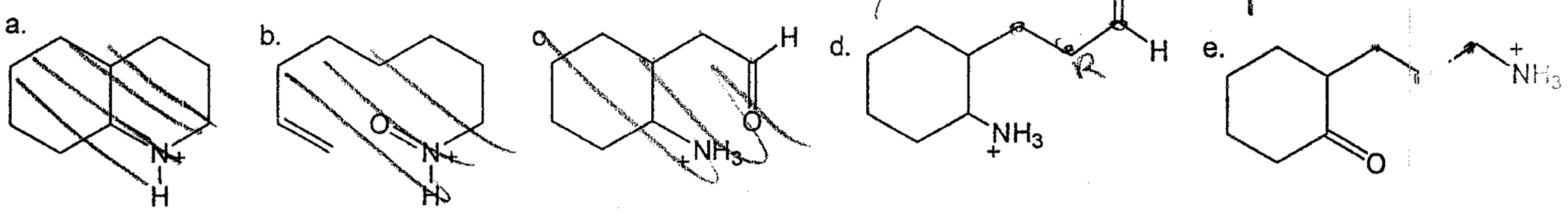
a. ~~1. $CH_3(CH_2)_3MgBr$ 3. H_3O^+~~
b. 1. $HO(CH_2)_2OH$, H^+ 2. $CH_3(CH_2)_3MgBr$ 3. H_3O^+
c. ~~1. $NaBH_4$ 2. H_3O^+ 3. $CH_3(CH_2)_3MgBr$ 4. H_3O^+~~
d. 1. $HO(CH_2)_2OH$, H^+ 2. $NaBH_4$ 3. H_3O^+ 4. $CH_3(CH_2)_3MgBr$ 5. H_3O^+
e. None of the above are valid syntheses

E

27. Hydrolysis of the following produces what?

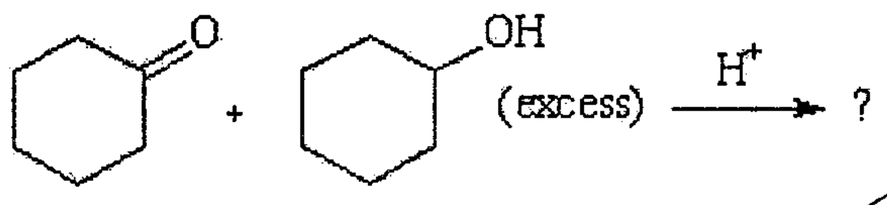


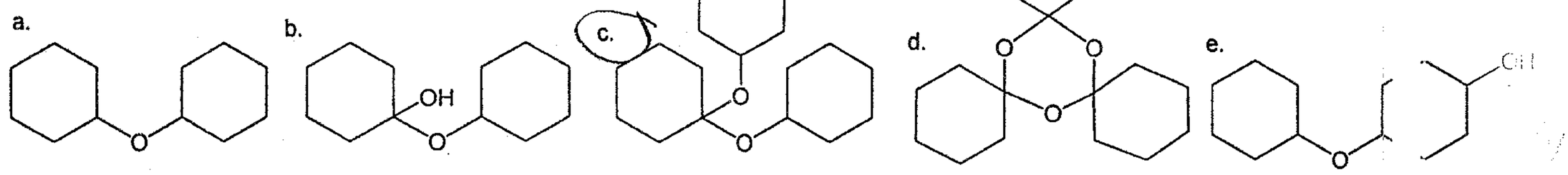
hydrolysis of amide

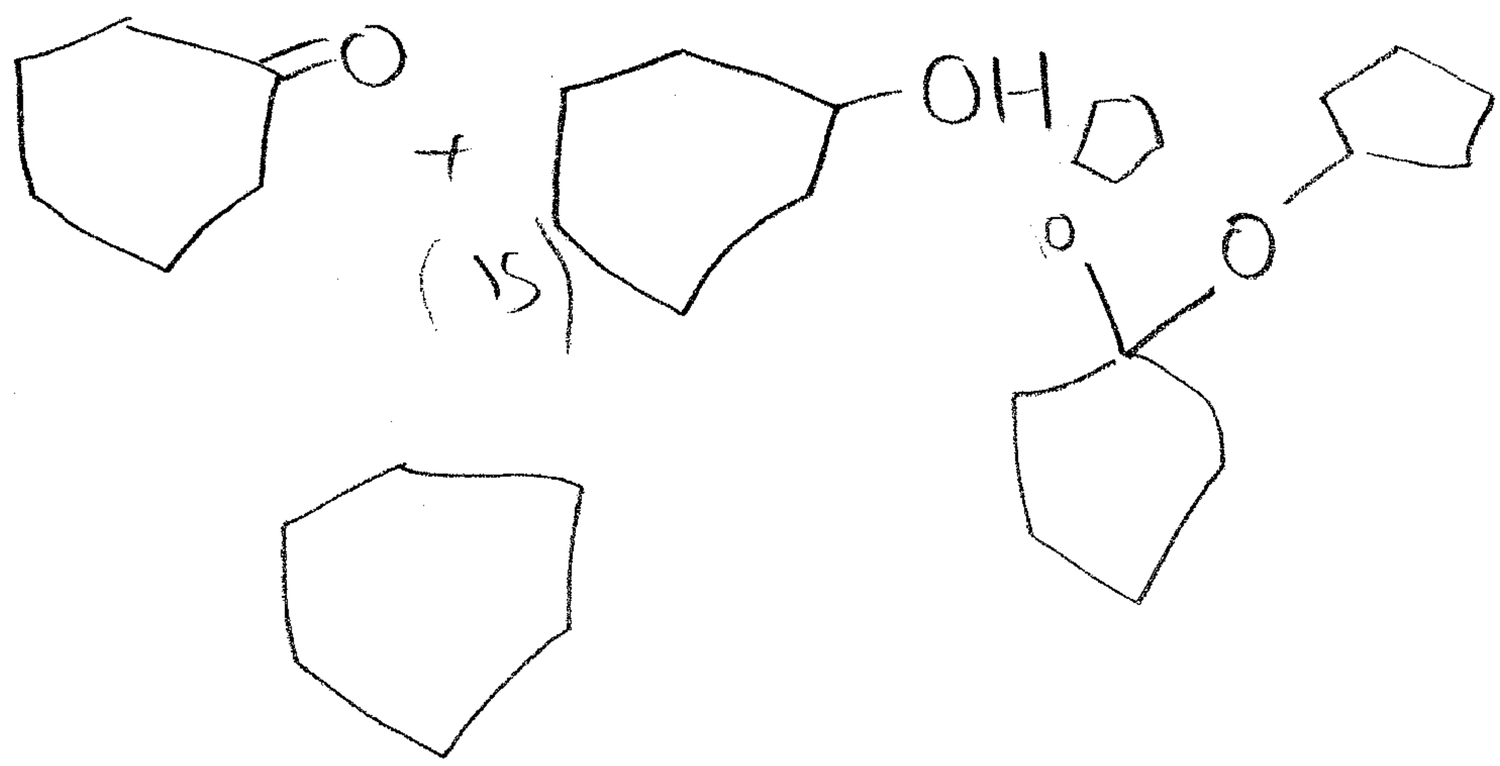


C

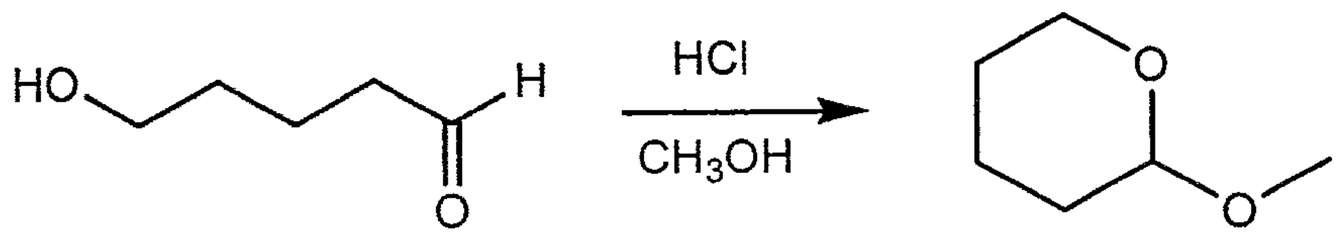
28. Indicate the major product.

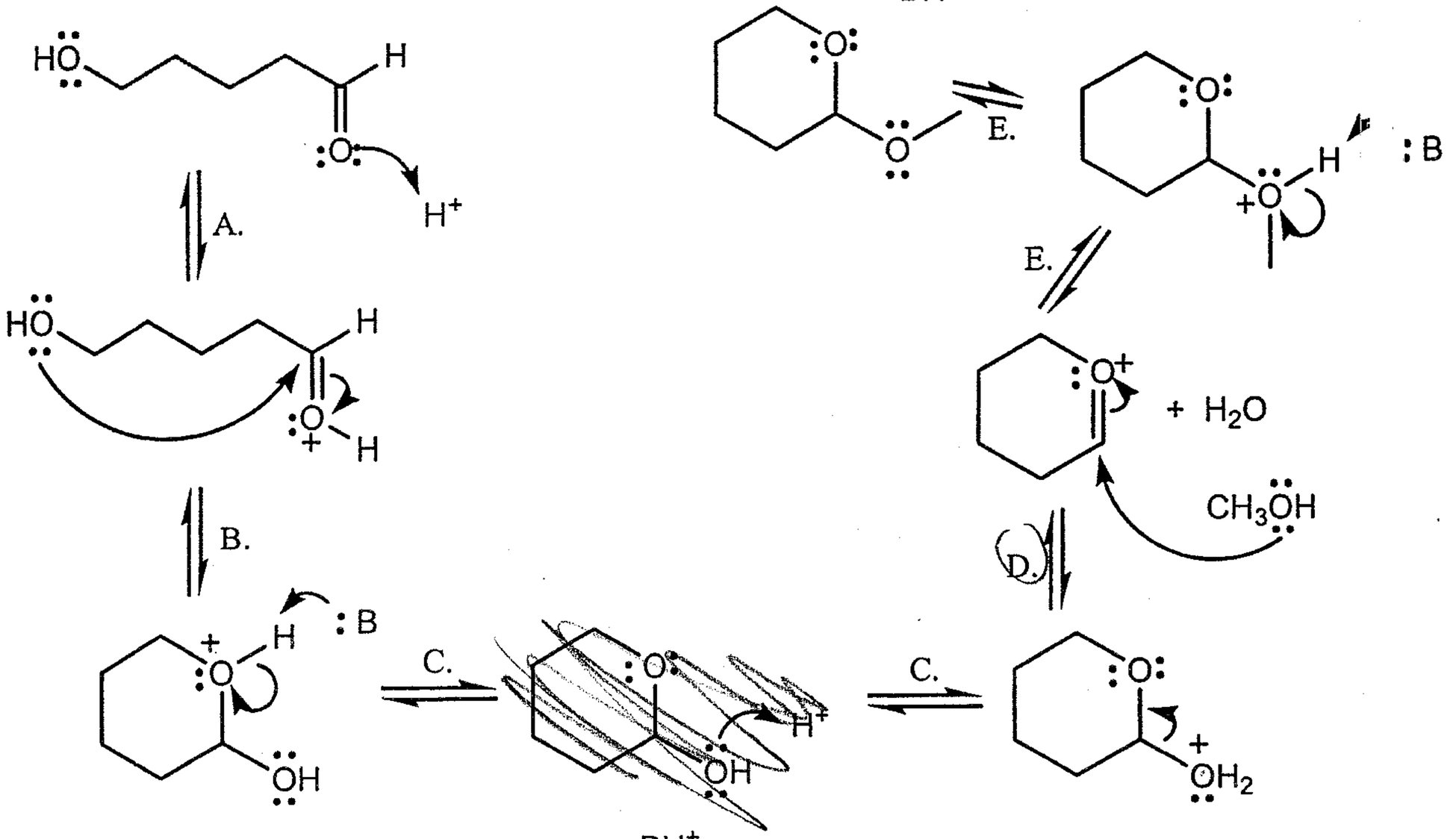






29. What mechanistic step is not shown properly for the following transformation?





30. Compound A reacts with sodium borohydride followed by acidification to generate alcohol, B. B reacts with propanoyl chloride to form product C, $C_6H_{12}O_2$, with the following ^1H NMR spectrum.

Compound C NMR			
δ	Approximate integration (mm)	# hydrogens	splitting
1.1	10	3	triplet
1.2	18	5	doublet
2.3	6	3	quartet
4.9	3	1	septet

Identify compound A.

a. ethanal b. propanal c. 2-propanone d. butanal e. 2-butanone