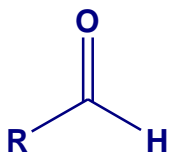
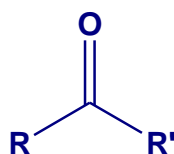


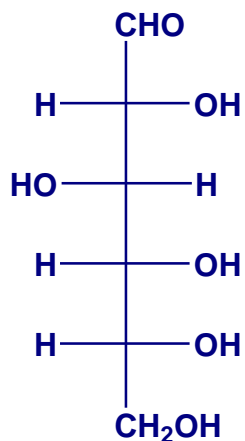
# Aldehydy i ketony



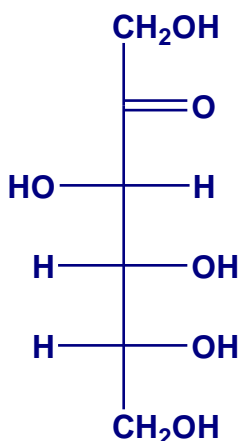
aldehydy



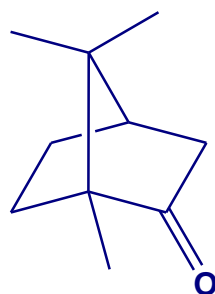
ketony



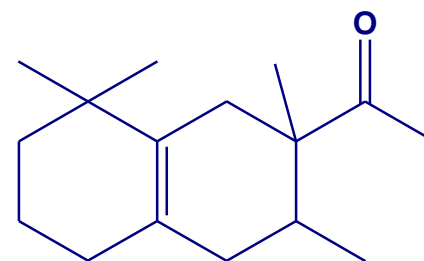
D-glukoza



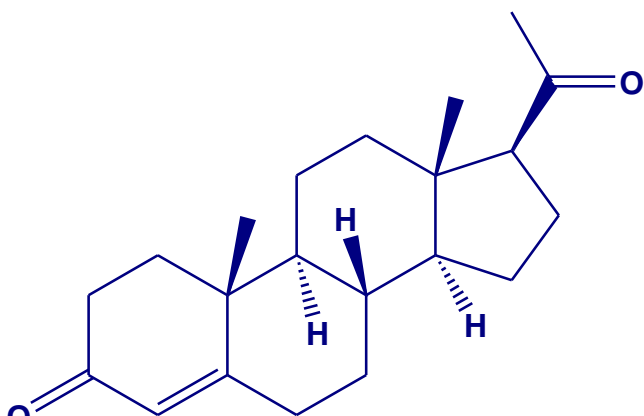
D-fruktoza



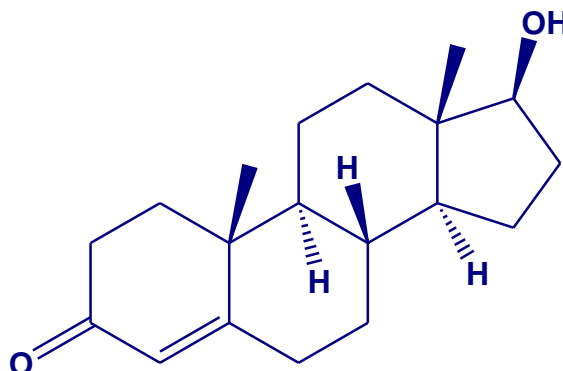
kamfora



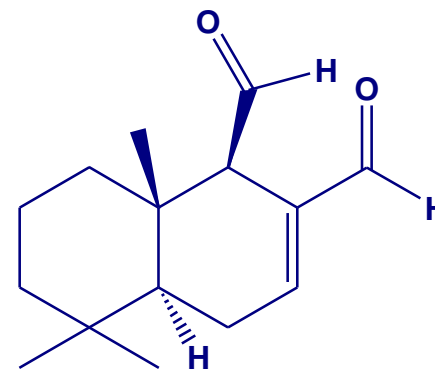
Iso E Super (perfumy Fahrenheit)



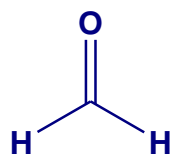
progesteron



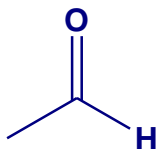
testosteron



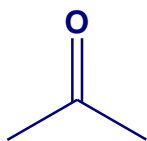
poligodial



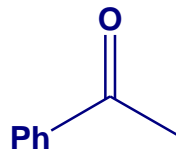
metanal  
formaldehyd



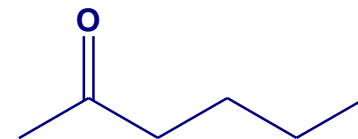
etanal  
aldehyd octowy



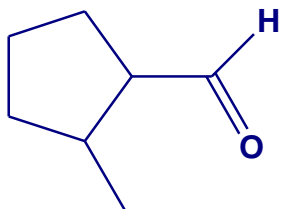
propanon  
keton dimetylowy  
aceton



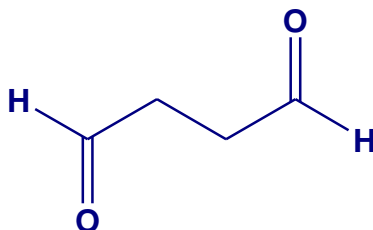
keton fenylowo-metylowy  
acetofenon



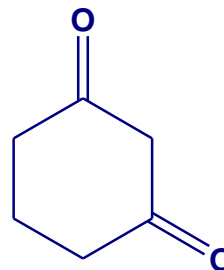
heksan-2-on  
2-oksoheksan  
keton *n*-butylowo-metylowy



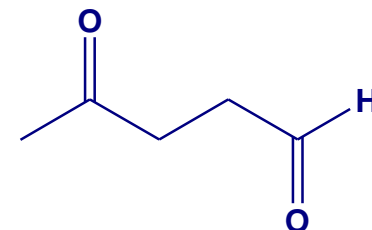
aldehyd 2-metylocyklopentylowy  
2-metylocyklopentanokarbaldehyd  
1-formylo-2-metylocyklopentan



butano-1,4-dial



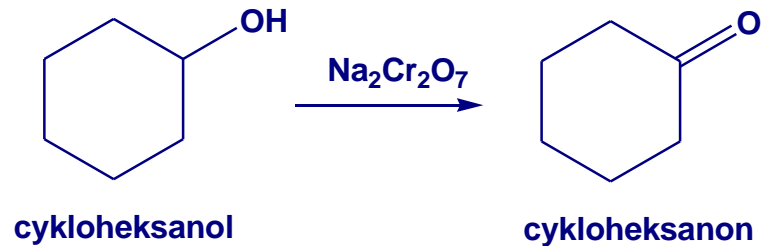
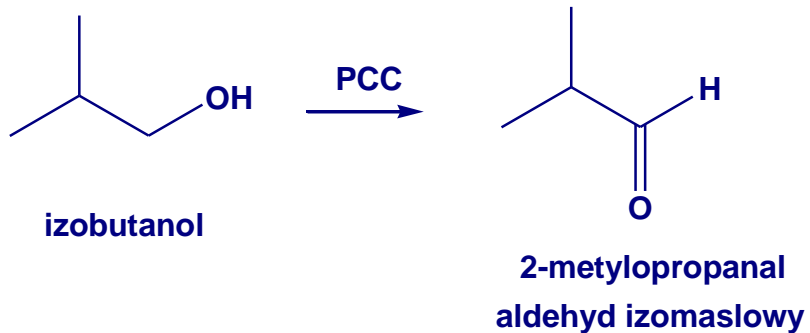
cykloheksano-1,3-dion



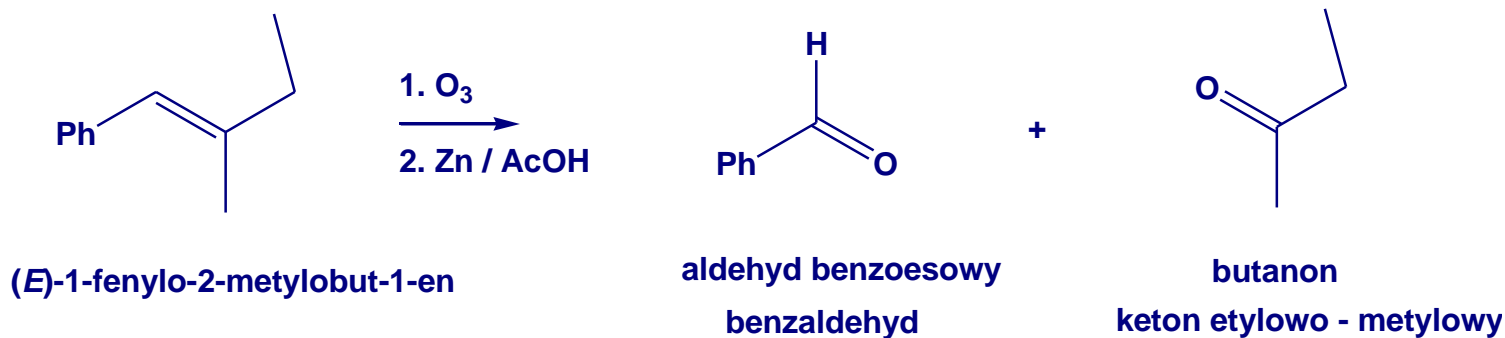
4-oksopentanal

# Otrzymywanie

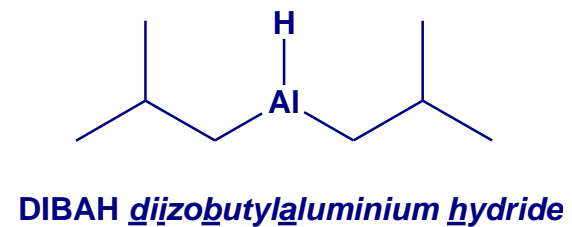
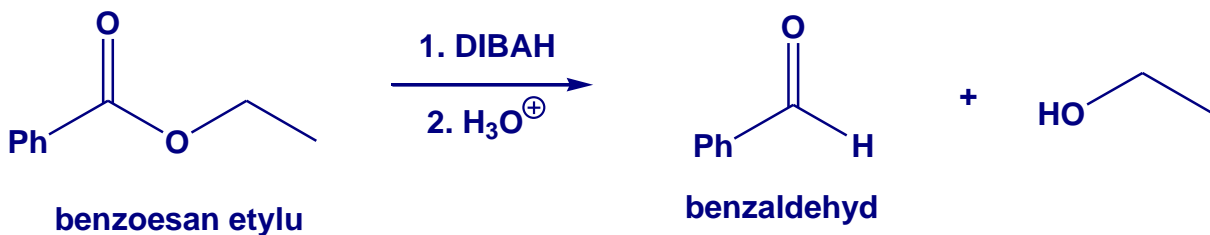
## Utlenianie alkoholi



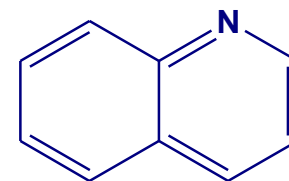
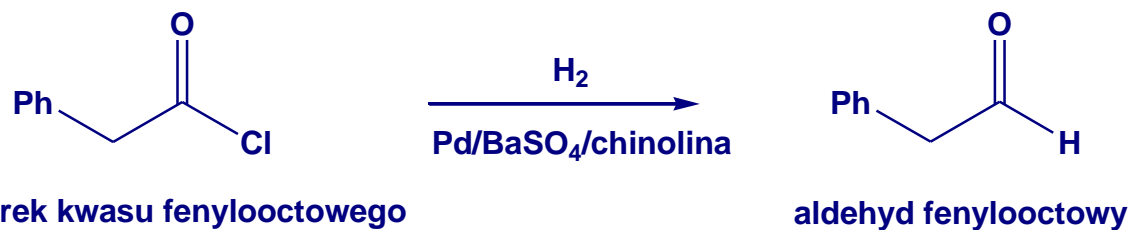
## Ozonoliza



## Redukcja pochodnych karboksylowych

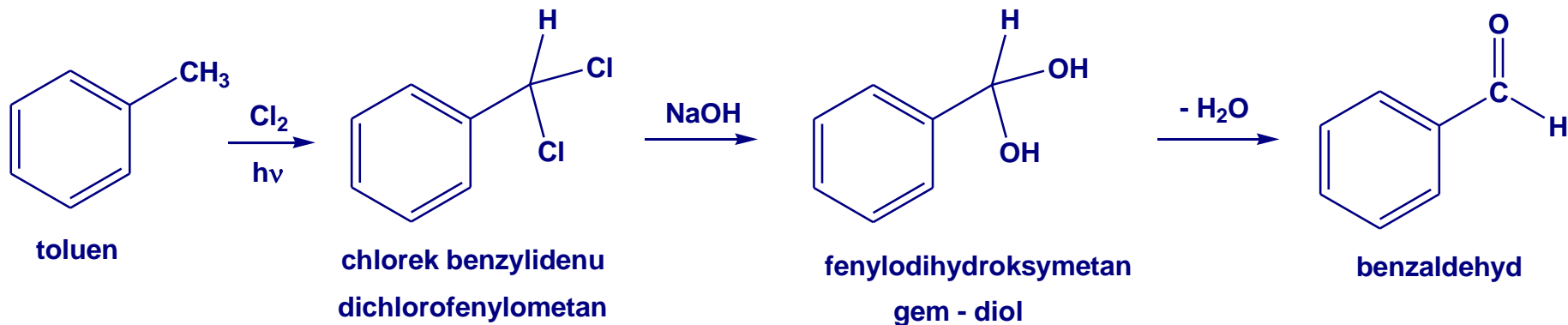


## Redukcja Rosenmunda

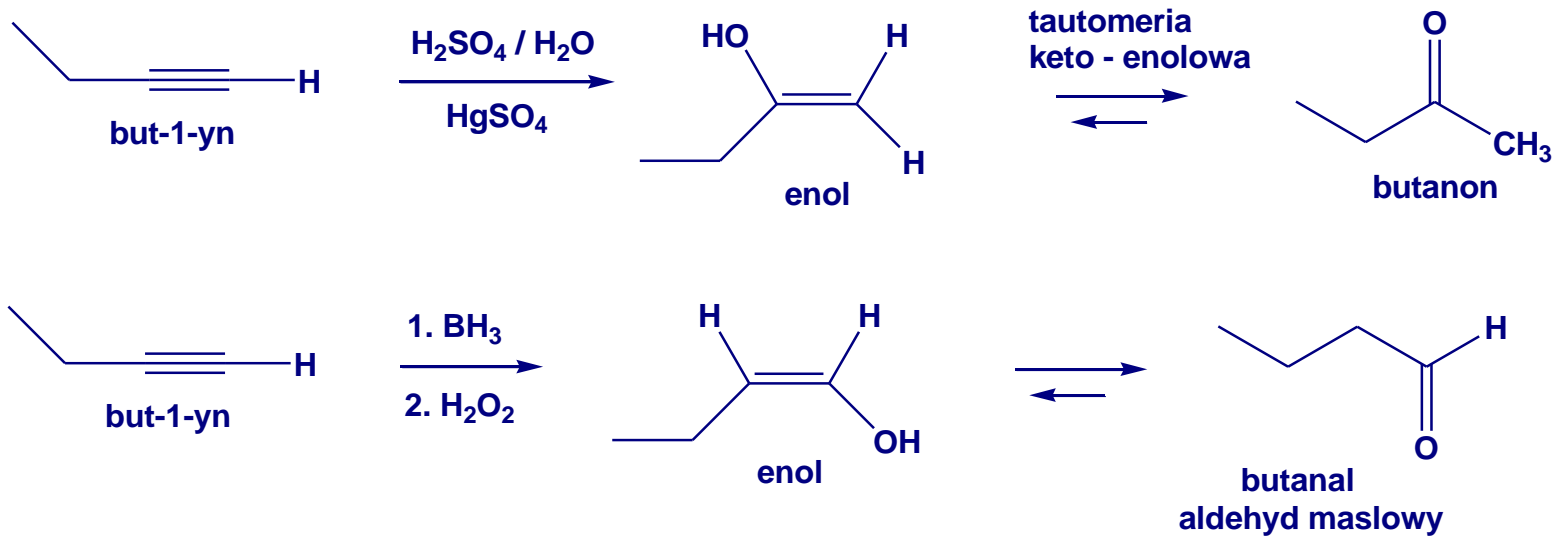


chinolina

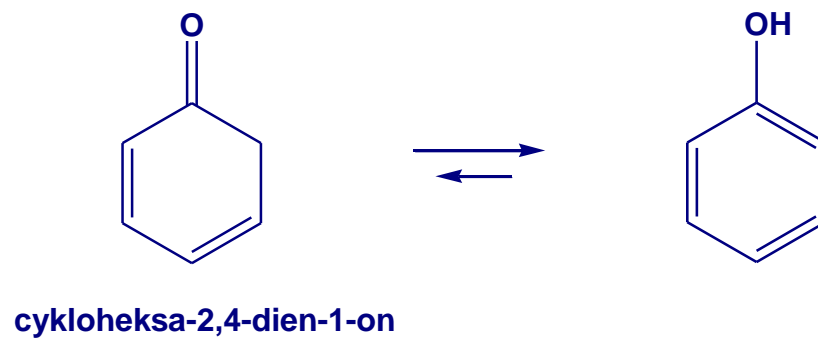
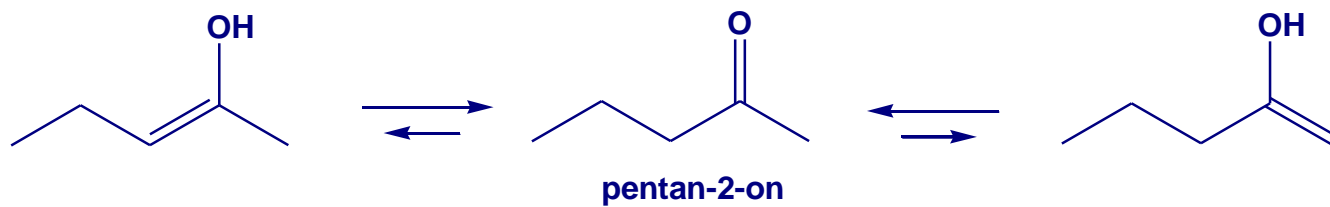
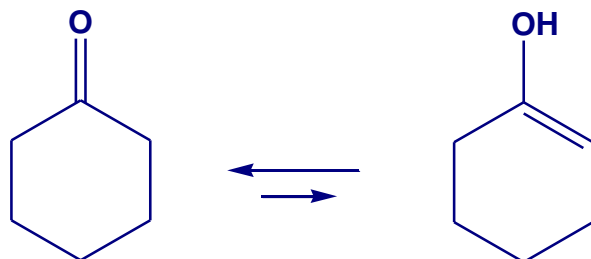
## Hydroliza geminalnych halogenopochodnych



## Hydratacja alkinów

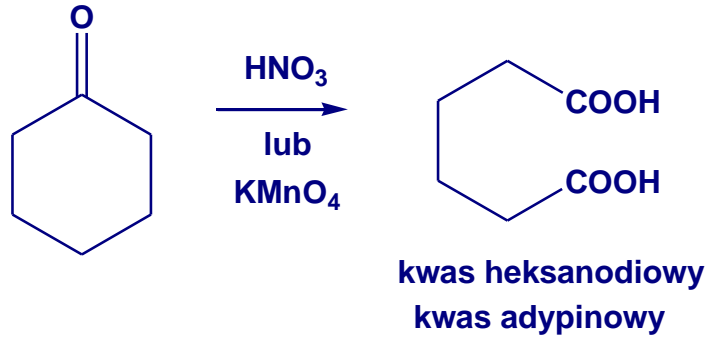


## Tautomeria keto - enolowa

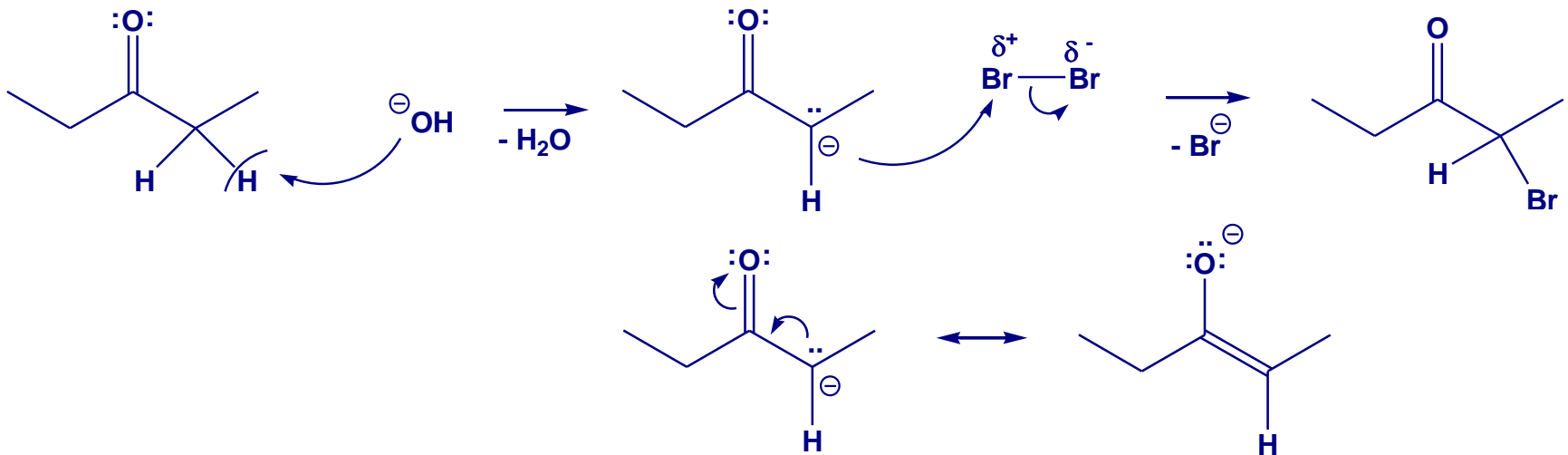
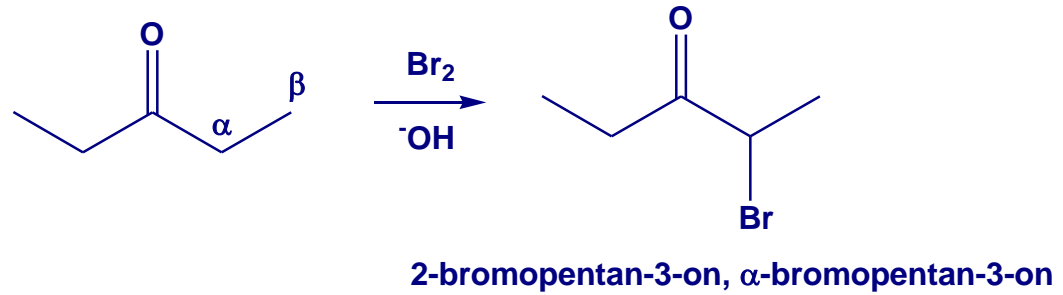


# Przykłady reakcji biegnących poprzez formę enolową

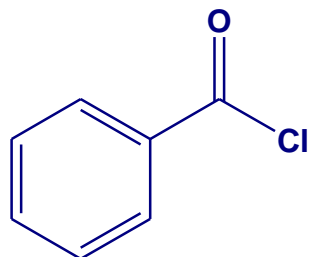
## Utlenianie



## Reakcja $\alpha$ -halogenowania

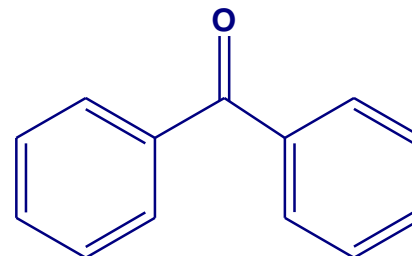
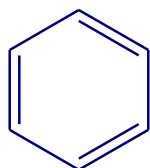


## Acylowanie Friedla - Craftsa

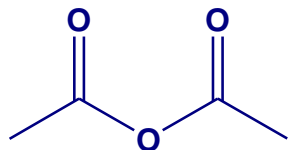


chlorek benzoilu  
chlorek kwasu benzoesowego

+

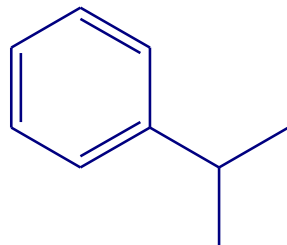


keton difenylowy  
benzofenon

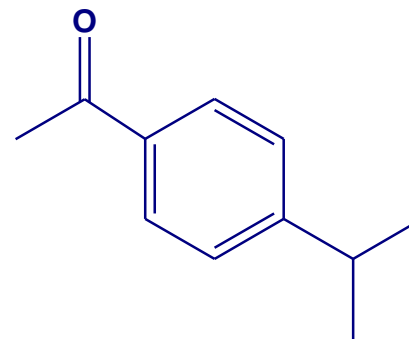


bezwodnik octowy

+



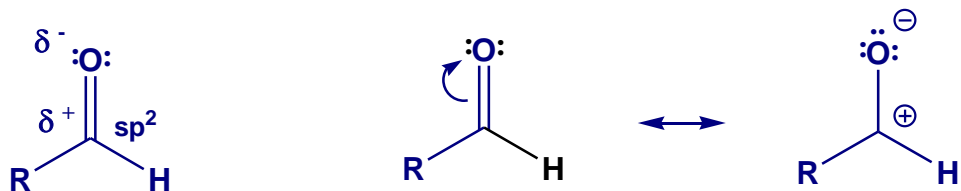
izopropylobenzen  
kumen



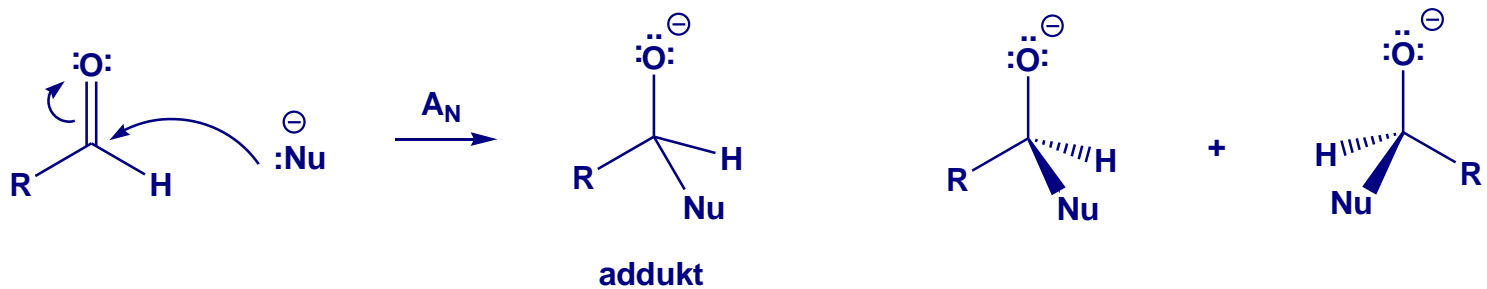
keton *p*-izopropylofenylowo - metylowy  
*p*-izopropyloacetofenon  
*p*-acetylokumen



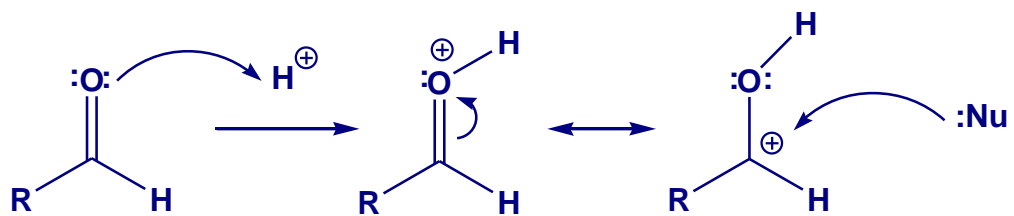
# Reaktywność aldehydów i ketonów



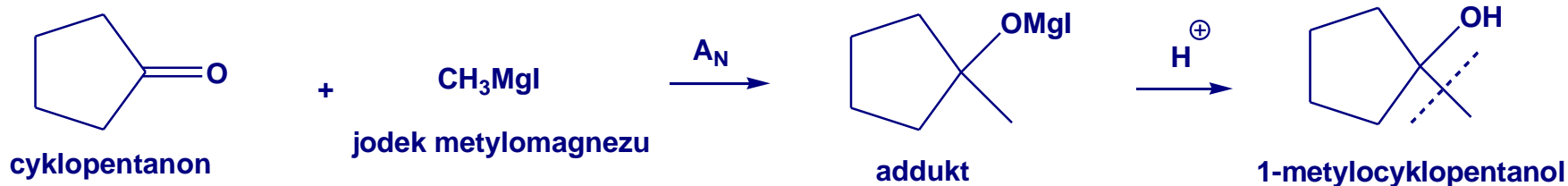
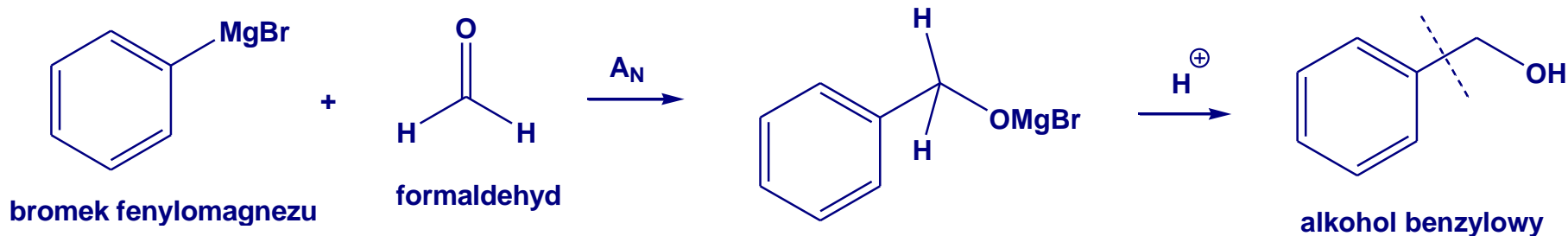
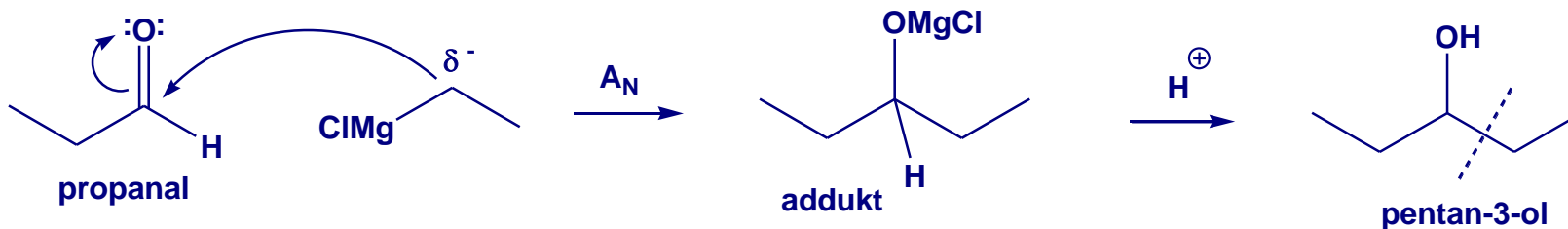
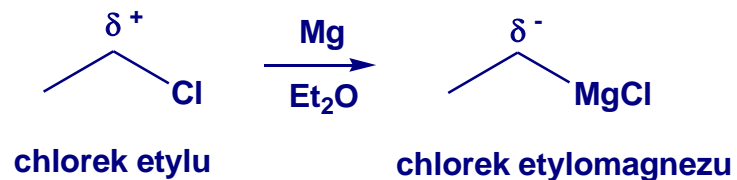
## $A_N$ - addycja nukleofilowa



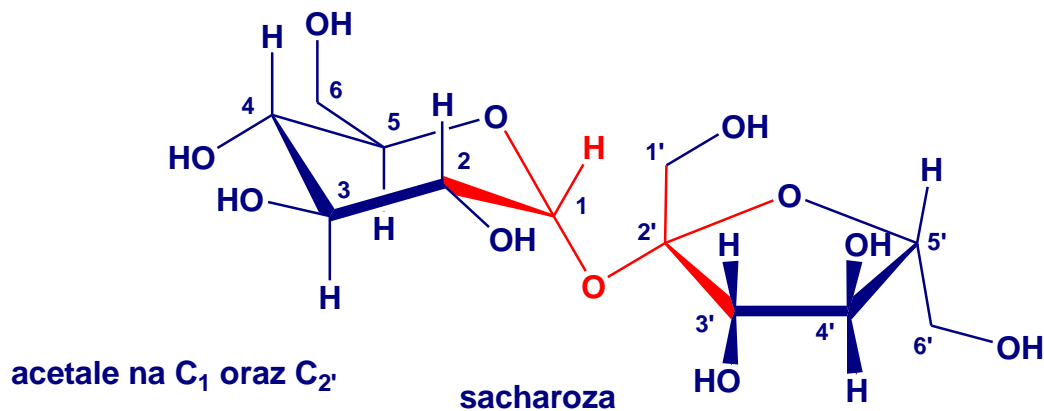
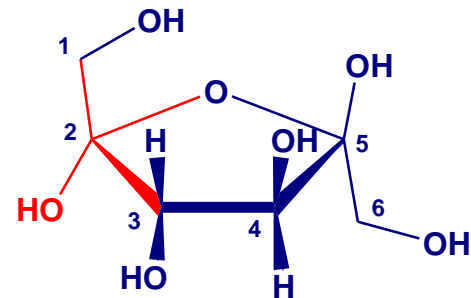
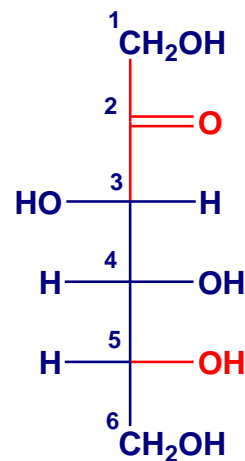
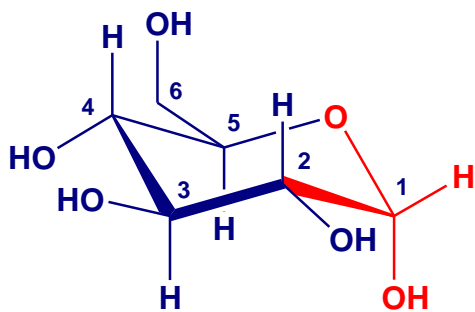
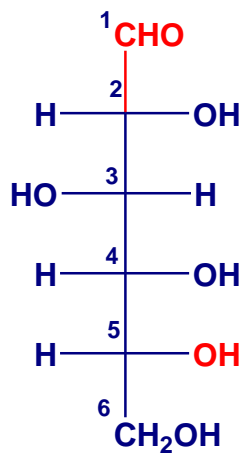
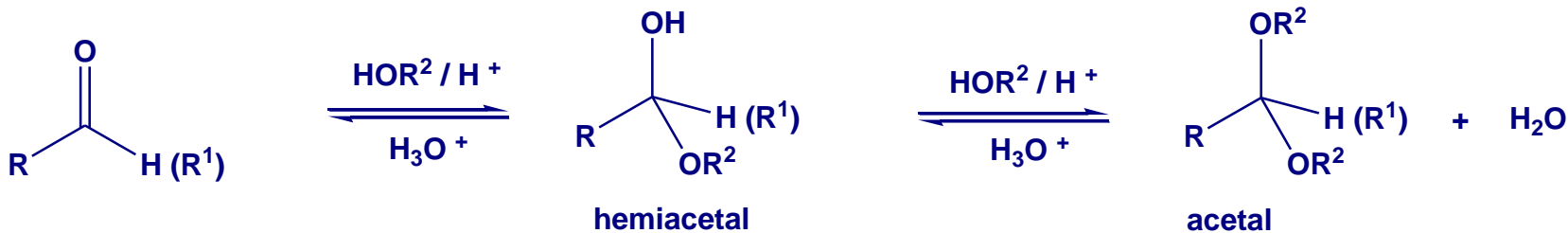
## Addycja nukleofilowa $A_N$ katalizowana przez kwas

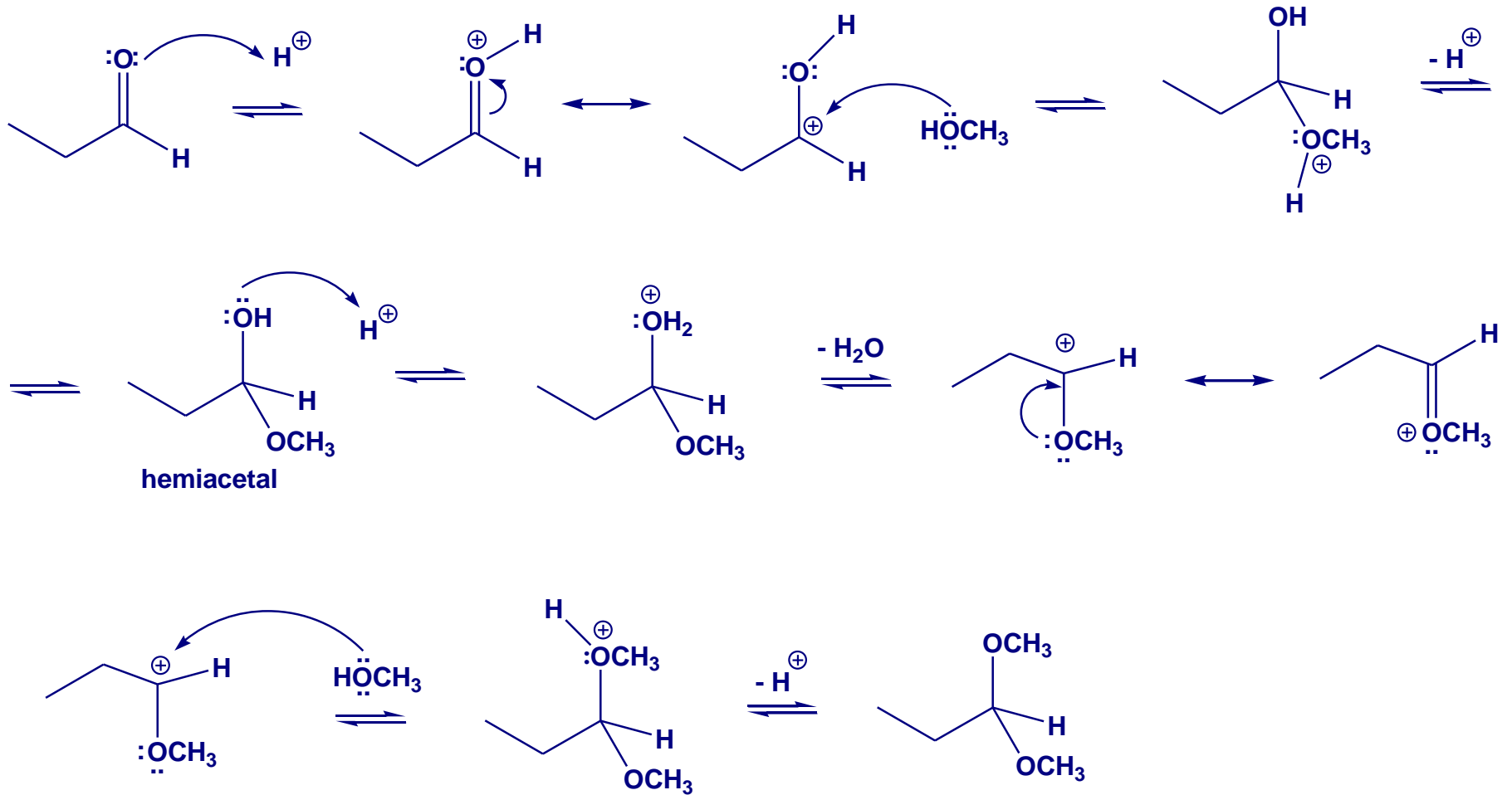
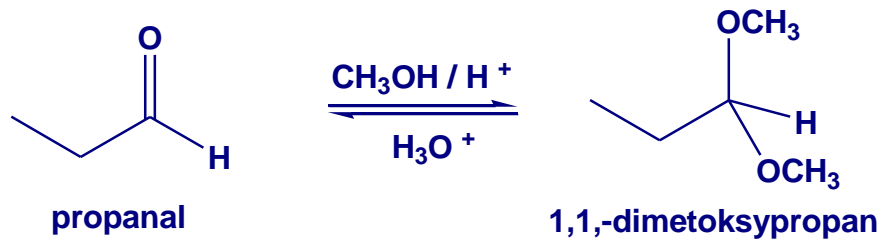


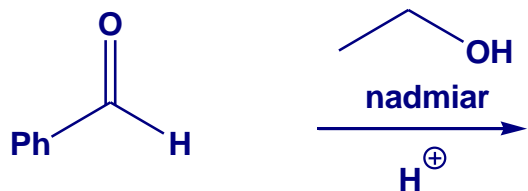
## Reakcja ze związkami magnezoorganicznymi (odczynnikami Grignarda)



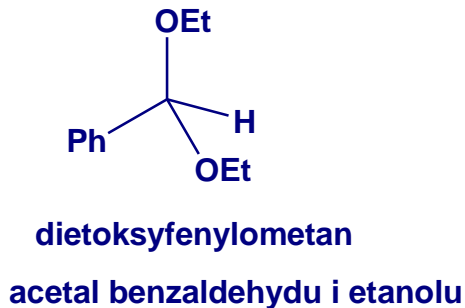
# Reakcje aldehydów i ketonów z alkoholami – hemiacetale i acetale



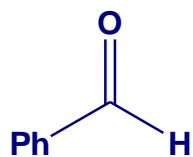




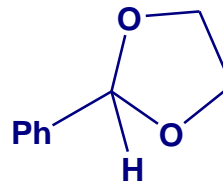
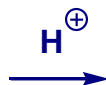
benzaldehyd



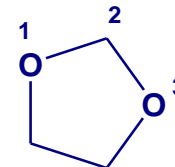
dietoksyfenylometan  
acetal benzaldehydu i etanolu



+

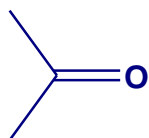


2-fenyl-1,3-dioksolan



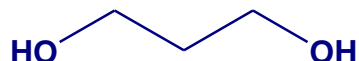
1,3-dioksolan

acetal benzaldehydu i glikolu etylenowego

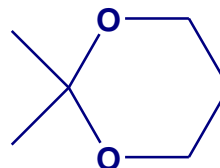
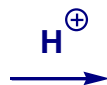


aceton

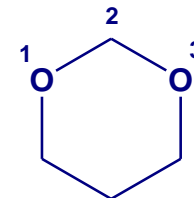
+



propano-1,3-diol

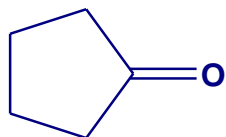


2,2-dimetylo-1,3-dioksan

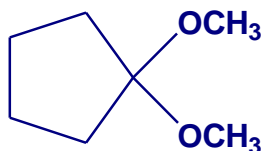
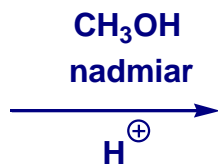


1,3-dioksan

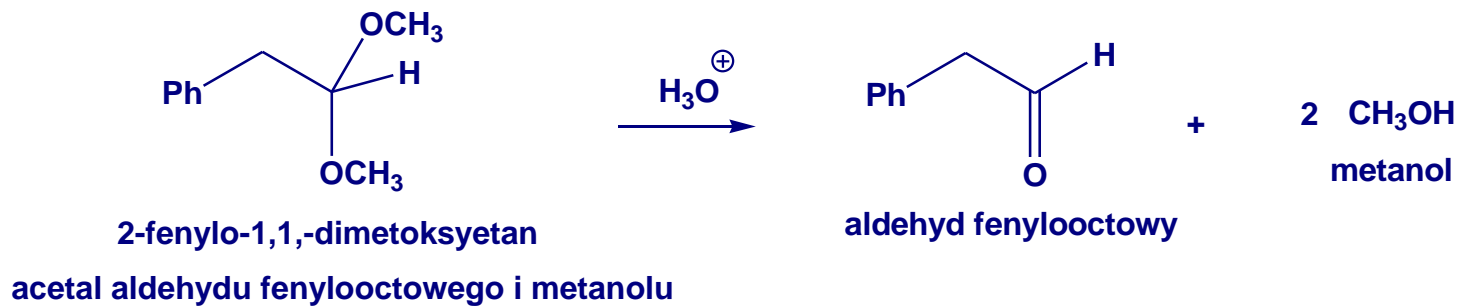
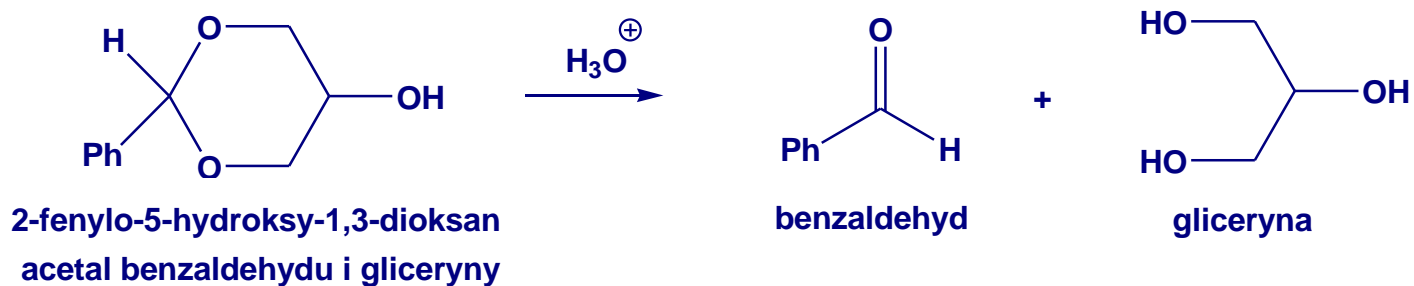
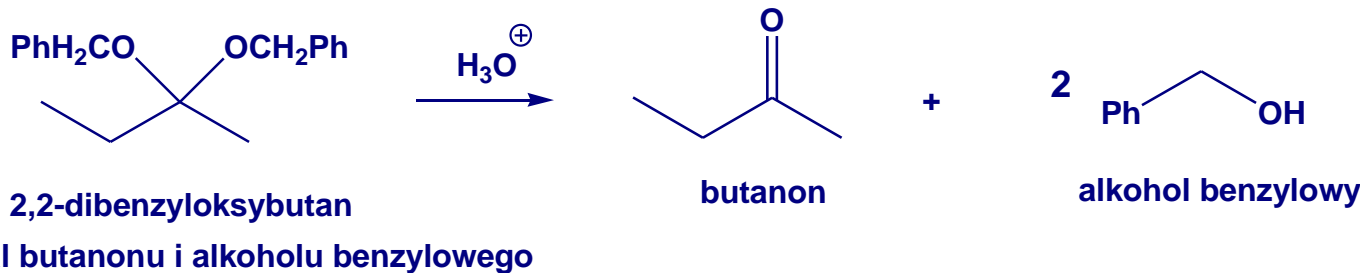
acetal acetonu i propano-1,3-diolu



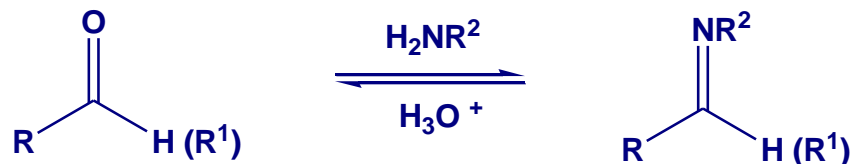
cyklopentanon



1,1-dimetoksykyclopentan  
acetal cyklopentanonu i metanolu

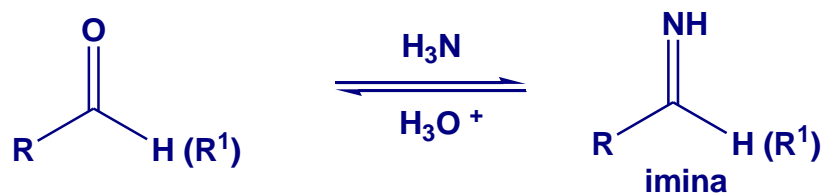


# Reakcje aldehydów i ketonów z amoniakiem oraz jego pochodnymi



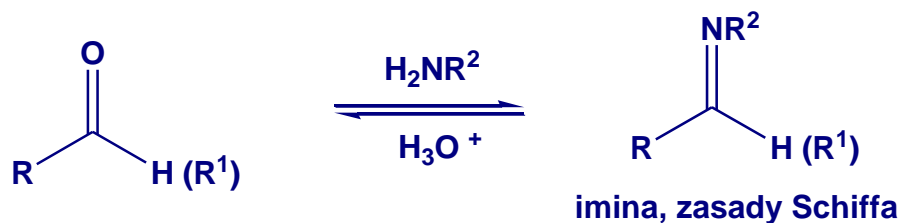
$\text{H}_2\text{NR}^2$   
 $\text{R}^2 = \text{H}$

$\text{NH}_3$   
amoniak



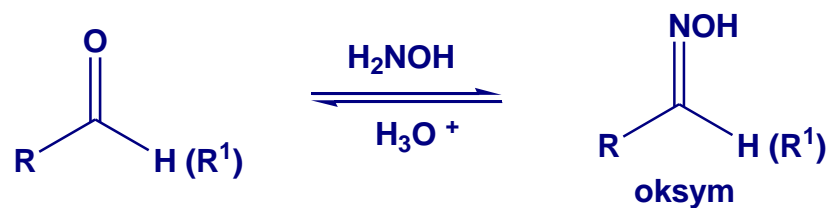
$\text{H}_2\text{NR}^2$   
 $\text{R}^2 = \text{alkil / aryl}$

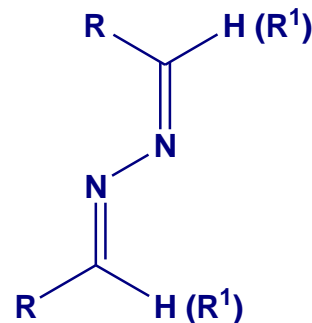
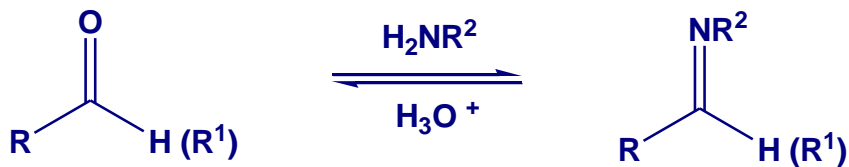
$\text{H}_2\text{NR}^2$   
amina



$\text{H}_2\text{NR}^2$   
 $\text{R}^2 = \text{OH}$

$\text{H}_2\text{NOH}$   
hydroksyloamina

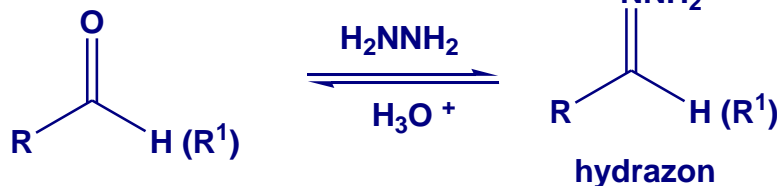




azyna

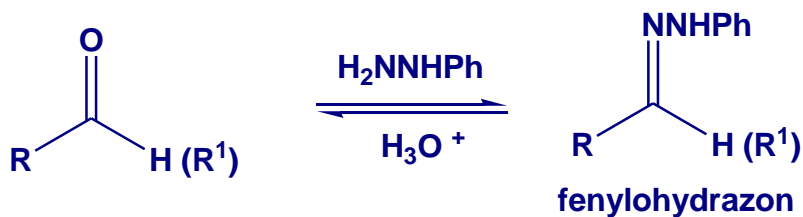
(dwukrotny nadmiar aldehydu lub ketonu)

$\text{H}_2\text{NR}^2$   
 $\text{R}^2 = \text{NH}_2$   
hydrazyna

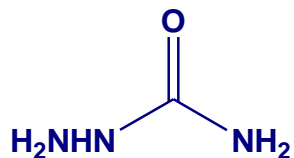
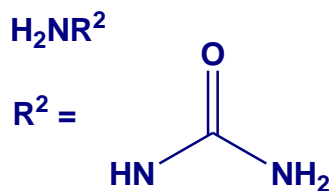


hydrazon

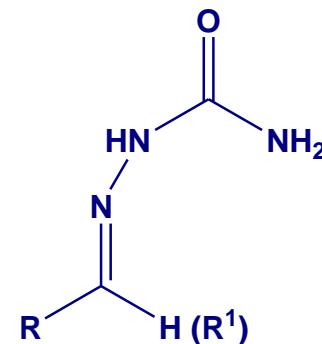
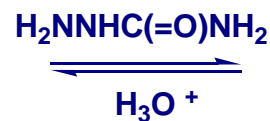
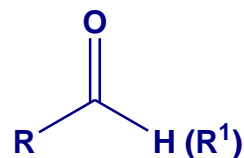
$\text{H}_2\text{NR}^2$   
 $\text{R}^2 = \text{NHPH}$   
fenylohydrazyna



fenylohydrazon



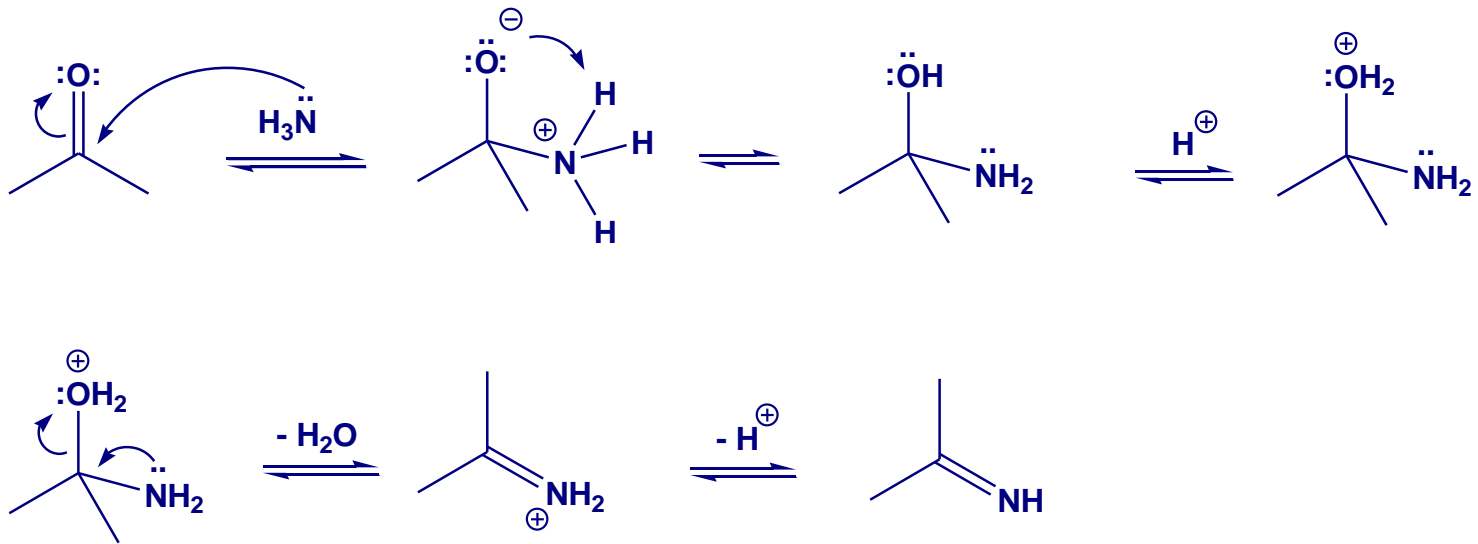
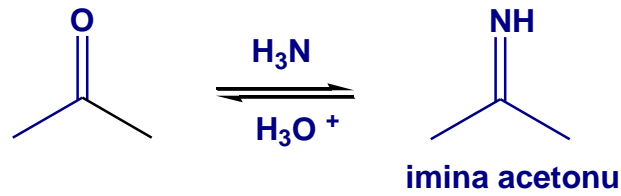
semikarbazyd



semikarbazon



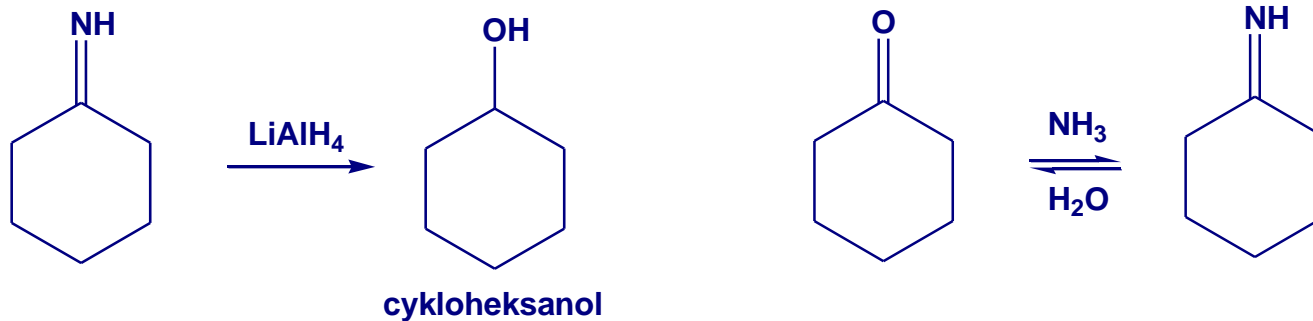
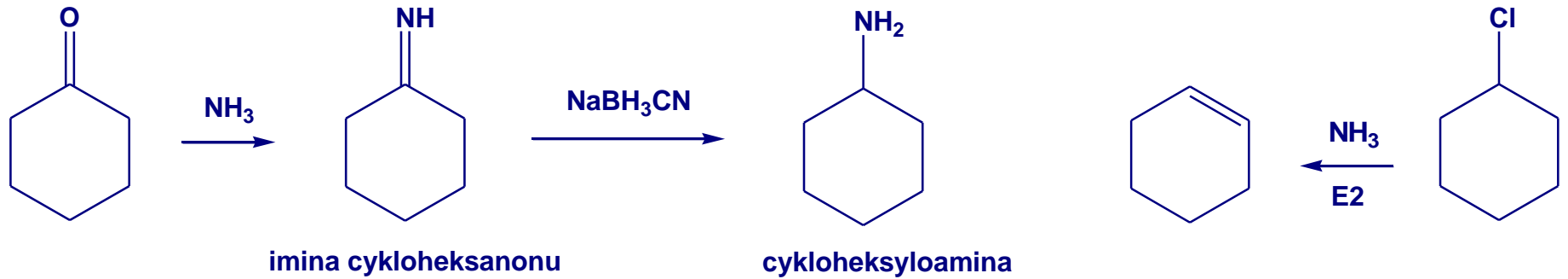
# Mechanizm na przykładzie iminy acetonu



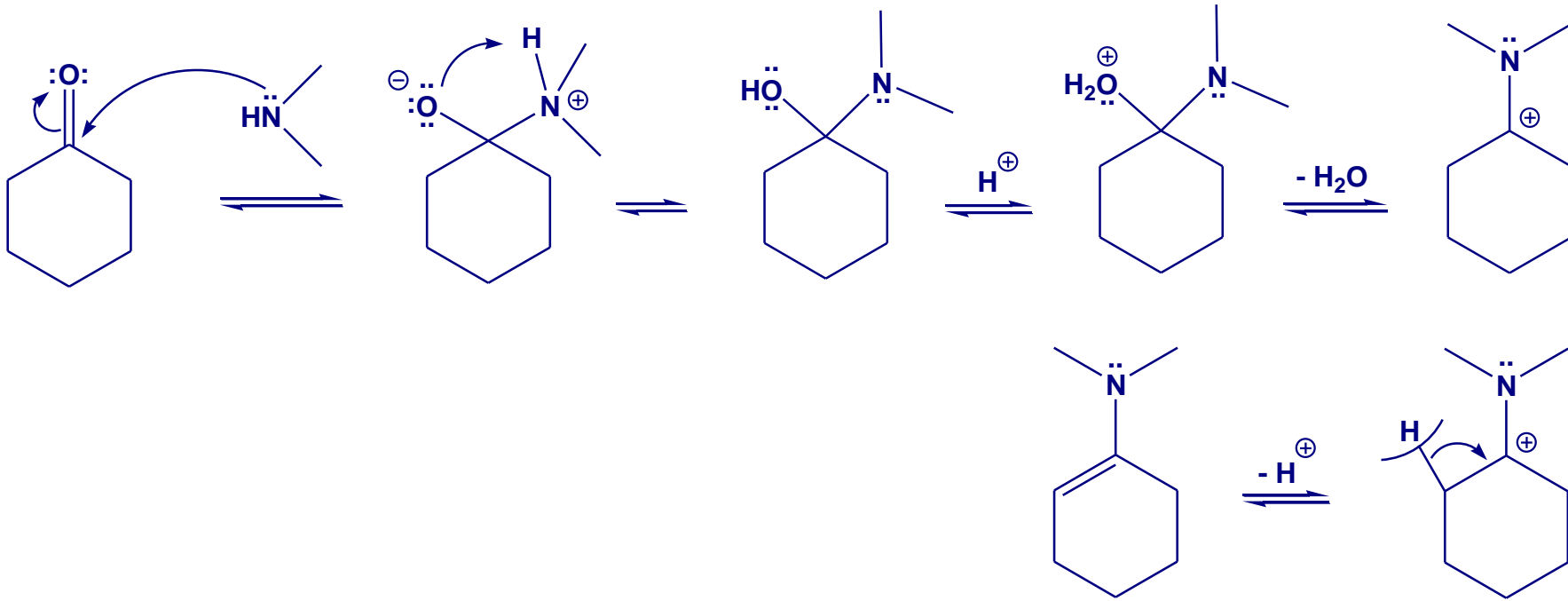
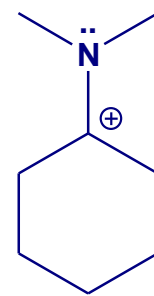
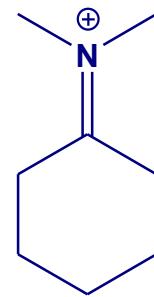
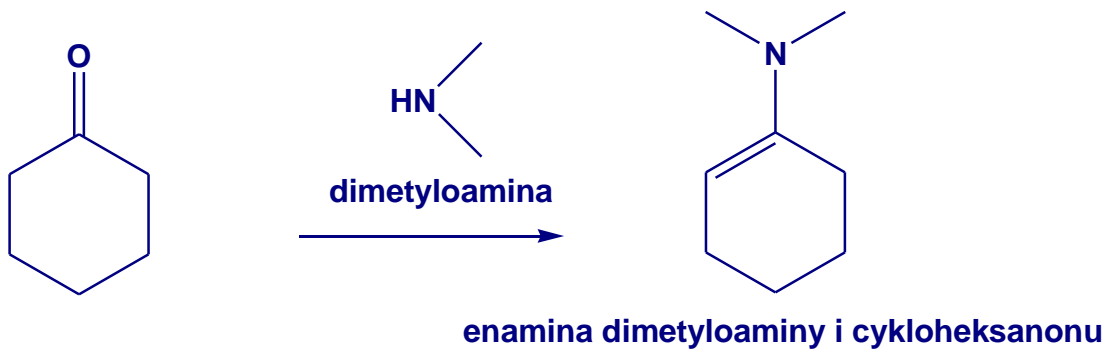
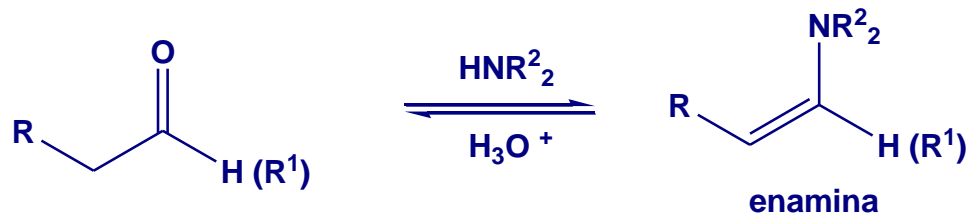
# Redukcyjne aminowanie



NaBH<sub>3</sub>CN - cyjanotrihydroboran sodu

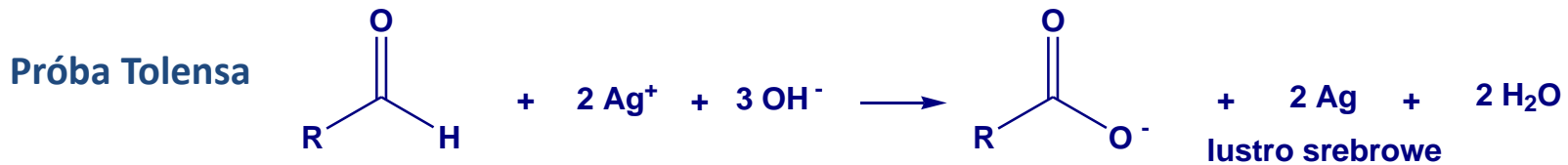
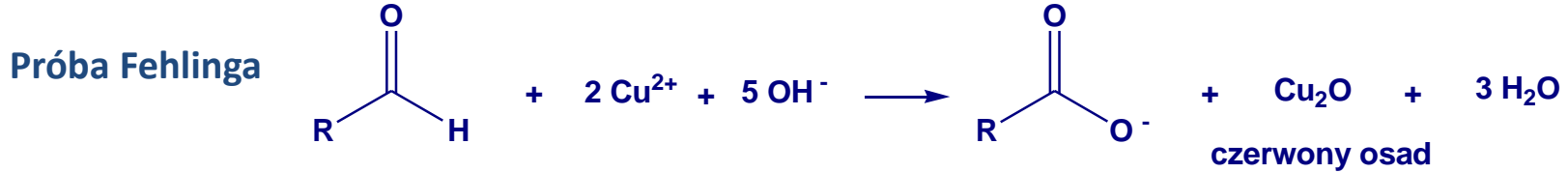


# Powstawanie enamin w reakcji z aminami drugorzędowymi

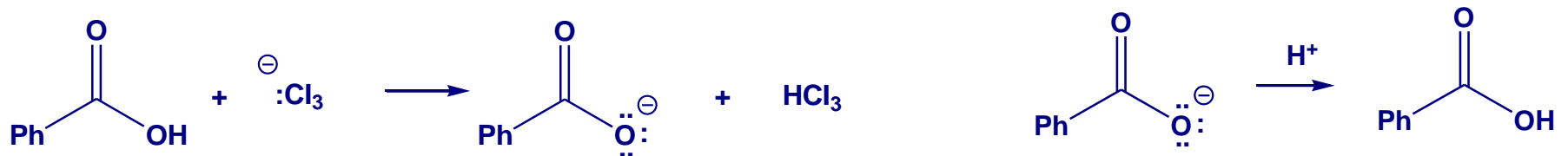
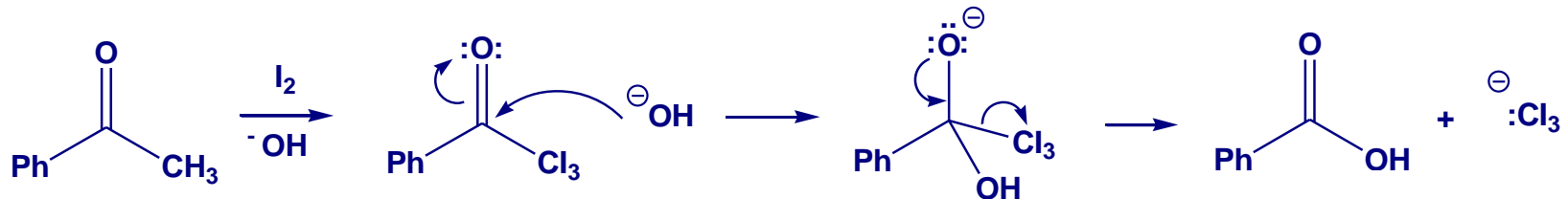
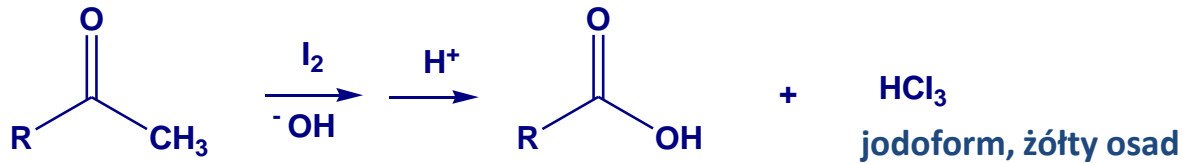


# Wybrane testy probówkowe aldehydów i ketonów

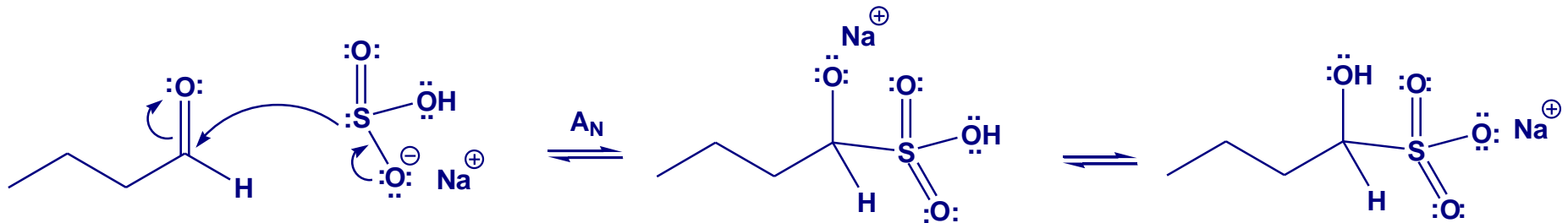
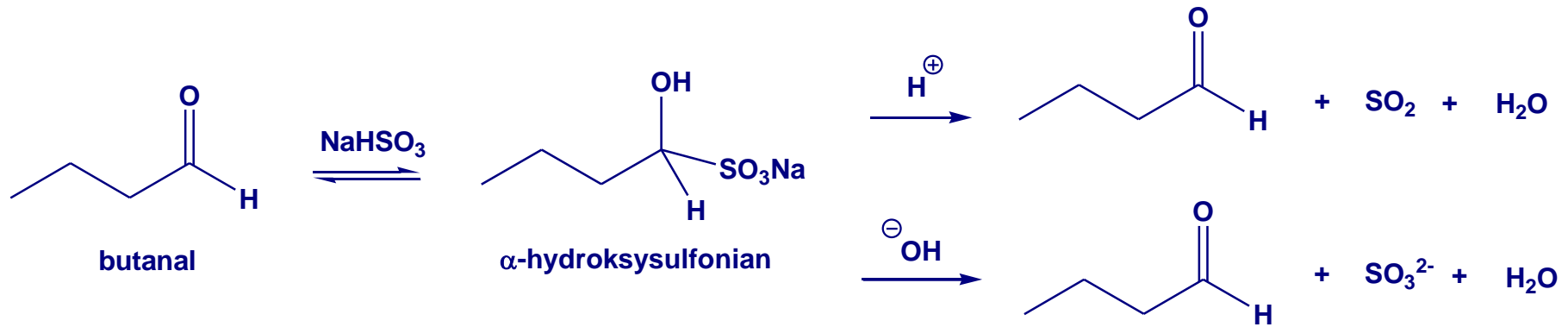
## Wykrywanie aldehydów poprzez utlenianie



## Wykrywanie ketonów z grupą metylową - reakcja haloformowa

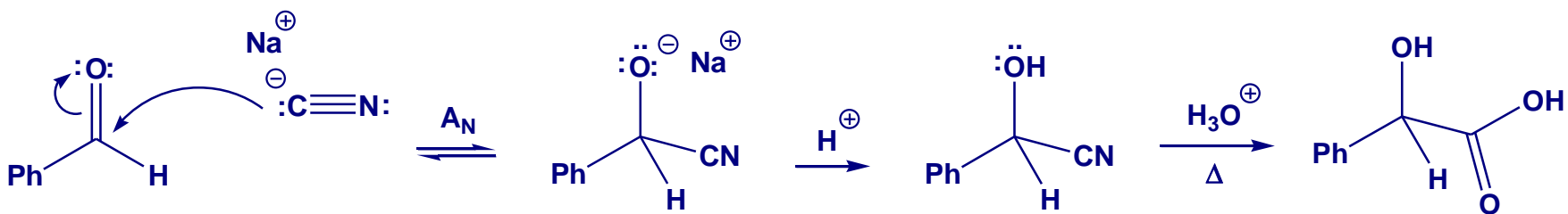
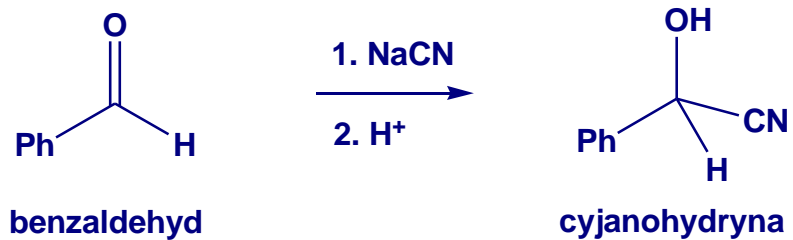


## Połączenia bisulfitowe, $\alpha$ -hydroksysulfoniany



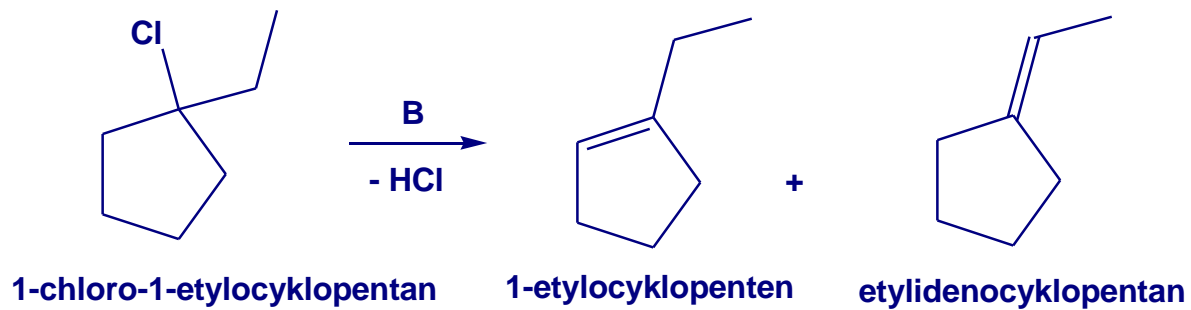
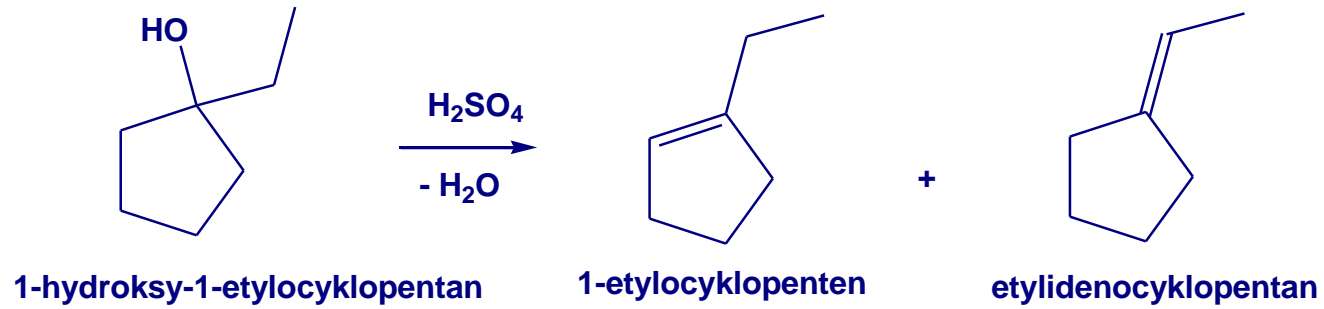
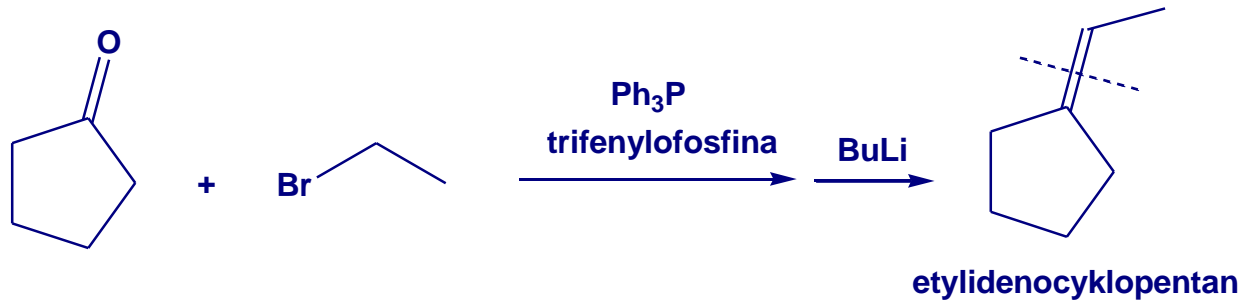
Ketony z rozbudowanymi podstawnikami (np. benzofenon  $\text{Ph}_2\text{C}=\text{O}$ ) nie reagują z wodorosiarczanem(IV) do  $\alpha$ -hydroksysulfonianów z powodu zawady sterycznej.

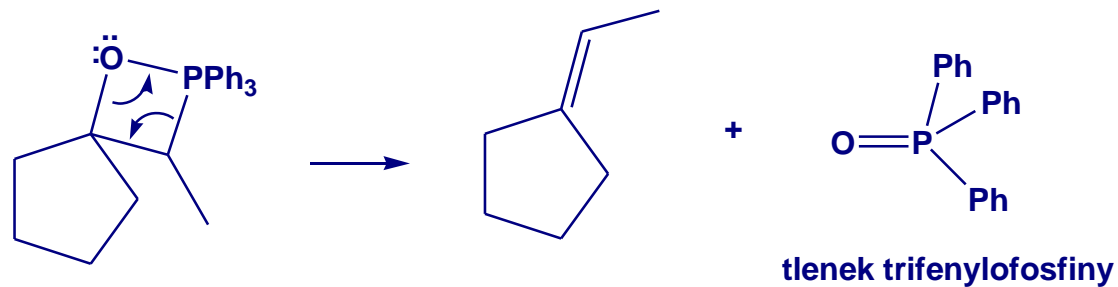
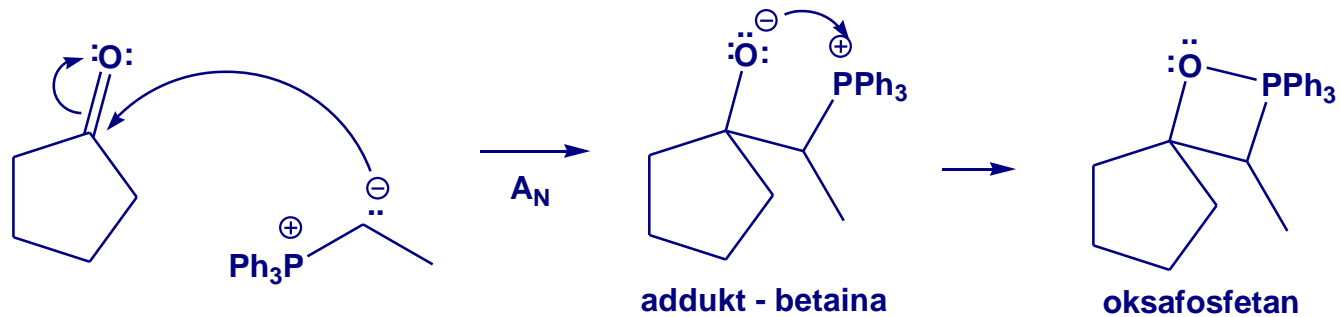
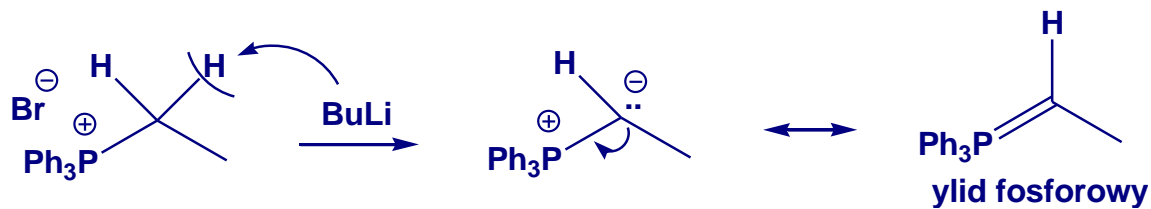
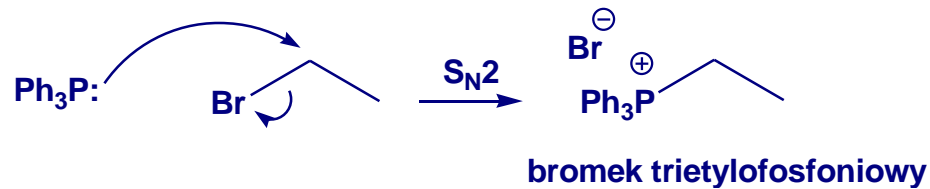
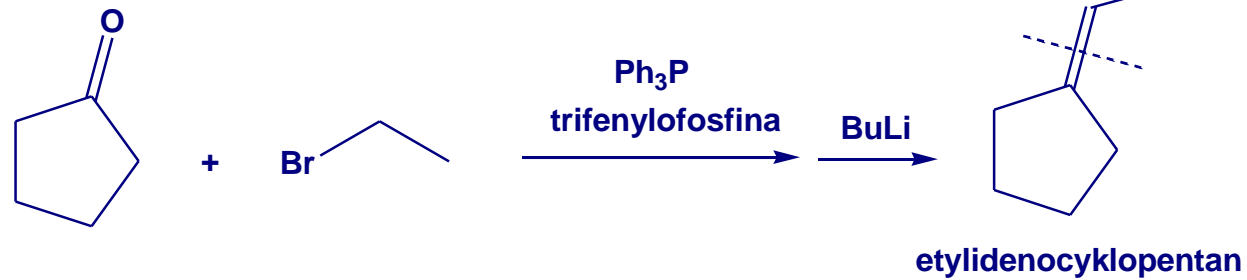
## Cyjanohydryny



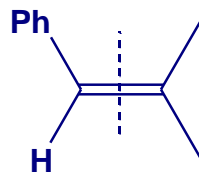
kwas 2-hydroksyfenylooctowy  
kwas  $\alpha$ -hydroksyfenylooctowy  
kwas migdałowy

# Reakcja Wittiga



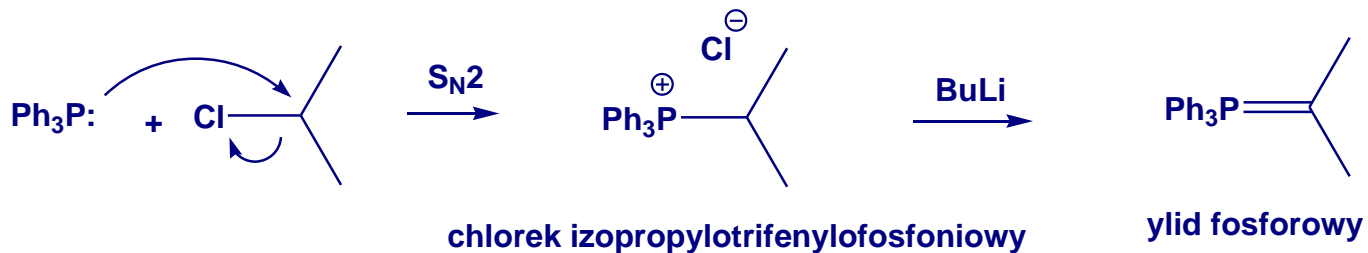




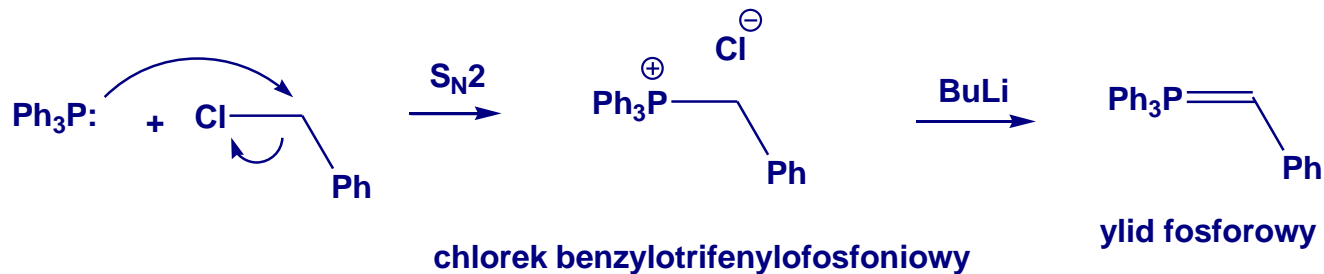
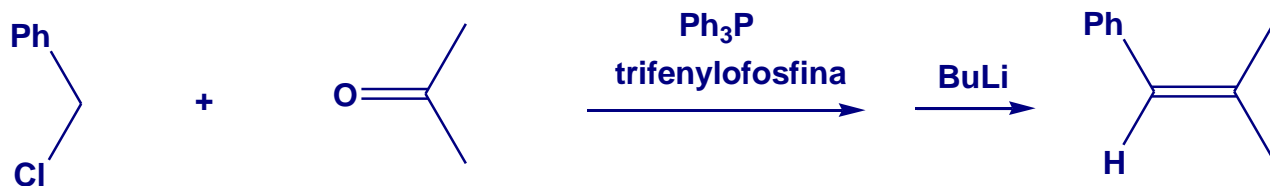


1-fenylo-2-metyloprop-1-en

1.

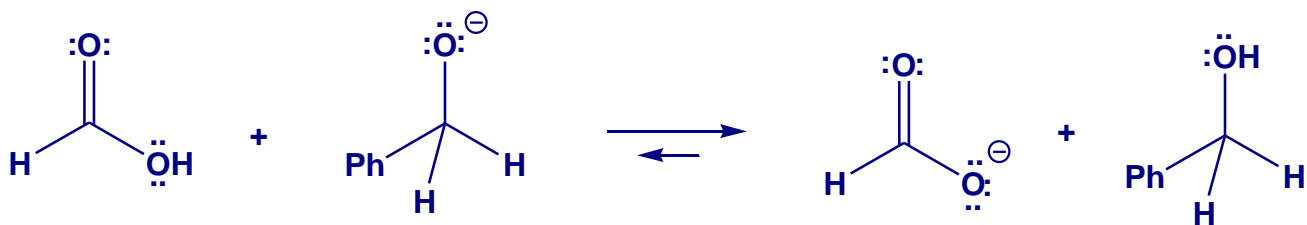
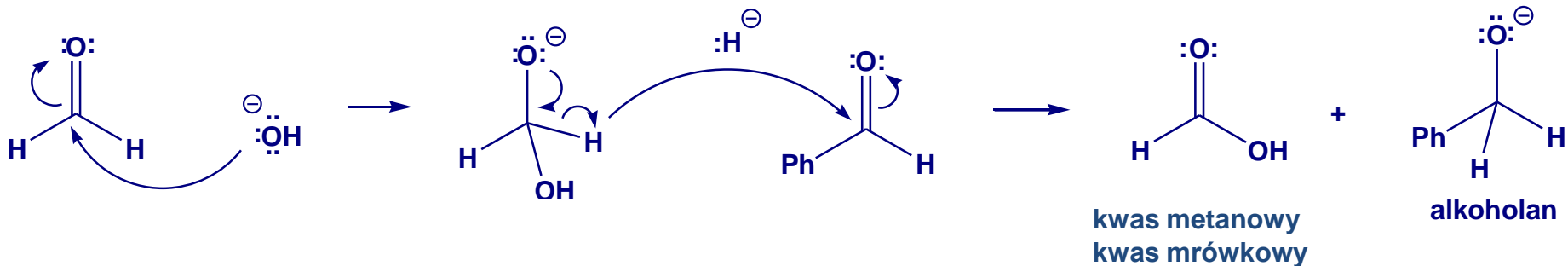
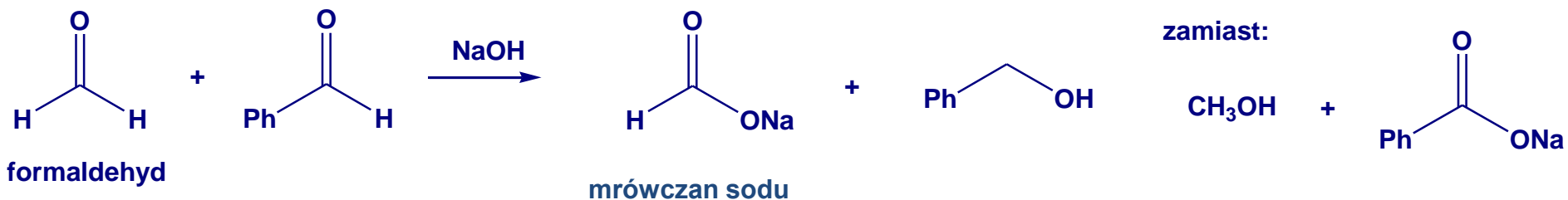
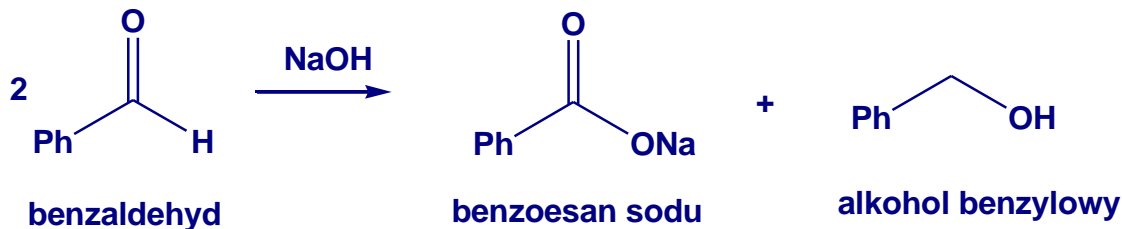


2.



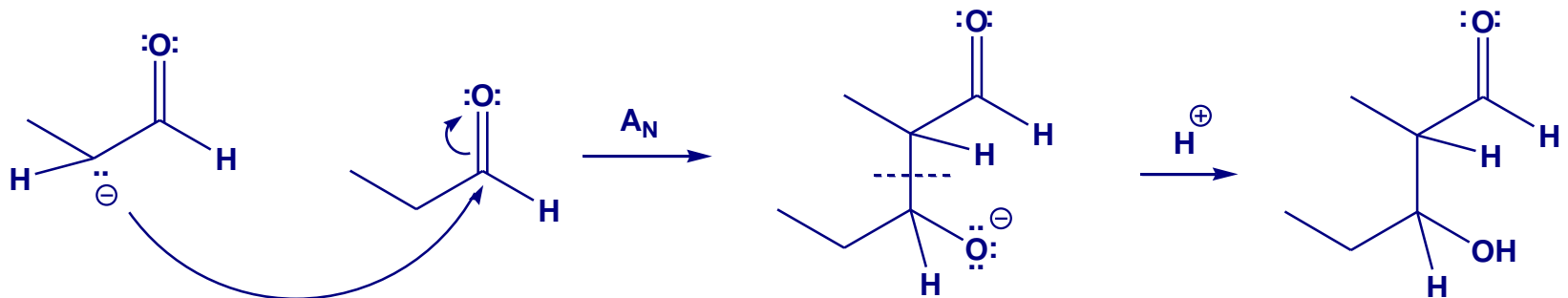
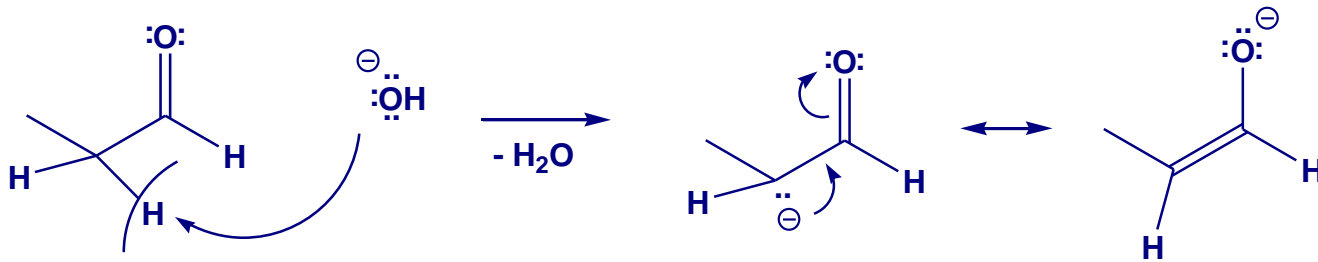
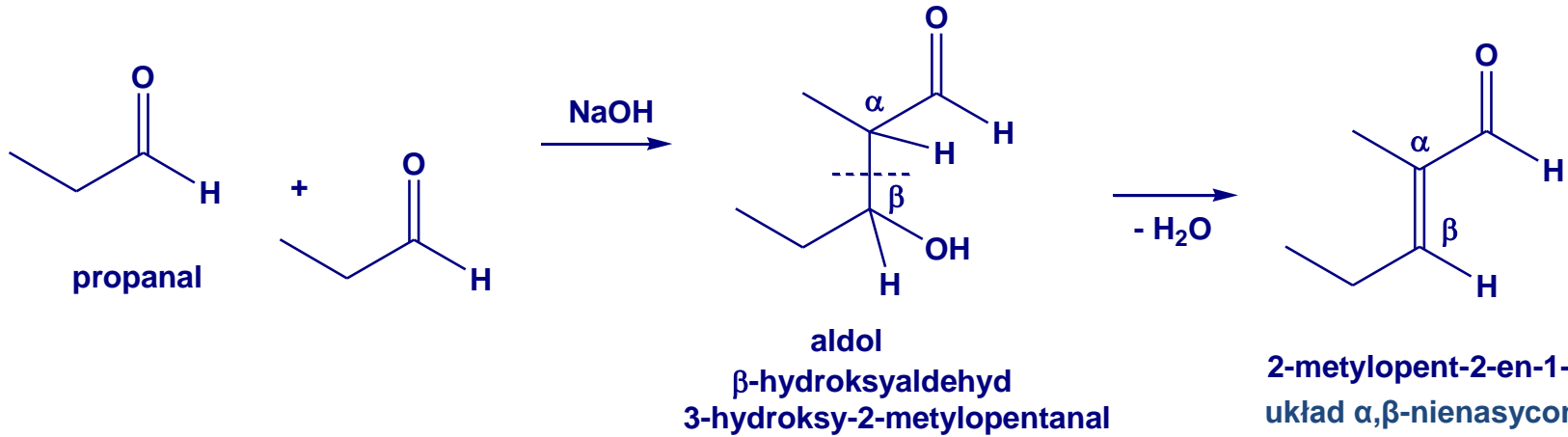
## Reakcja Cannizarro

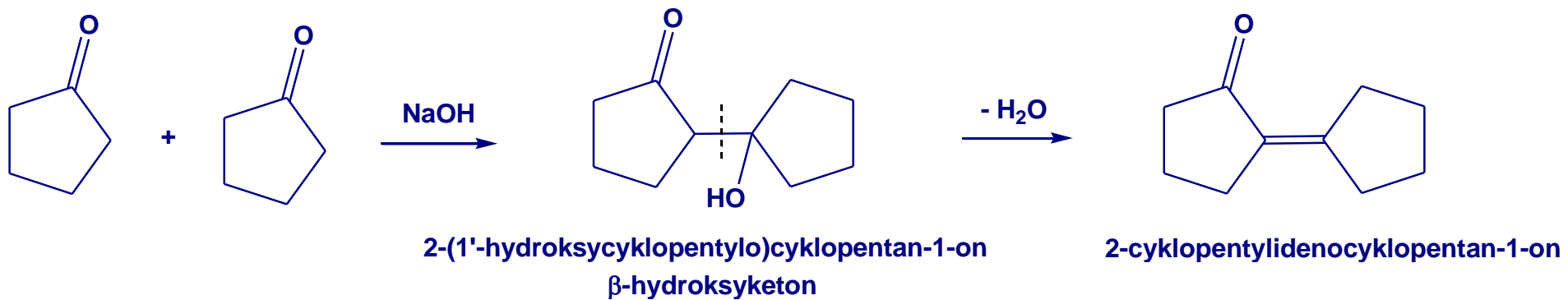
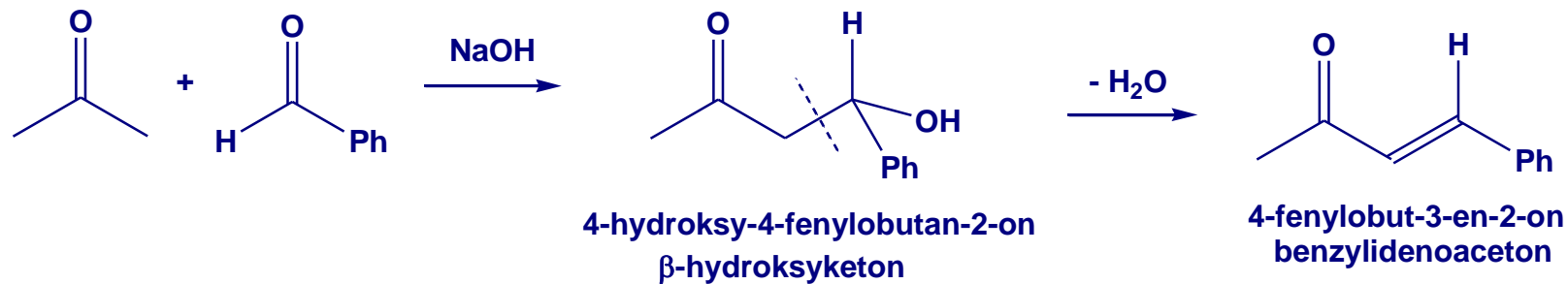
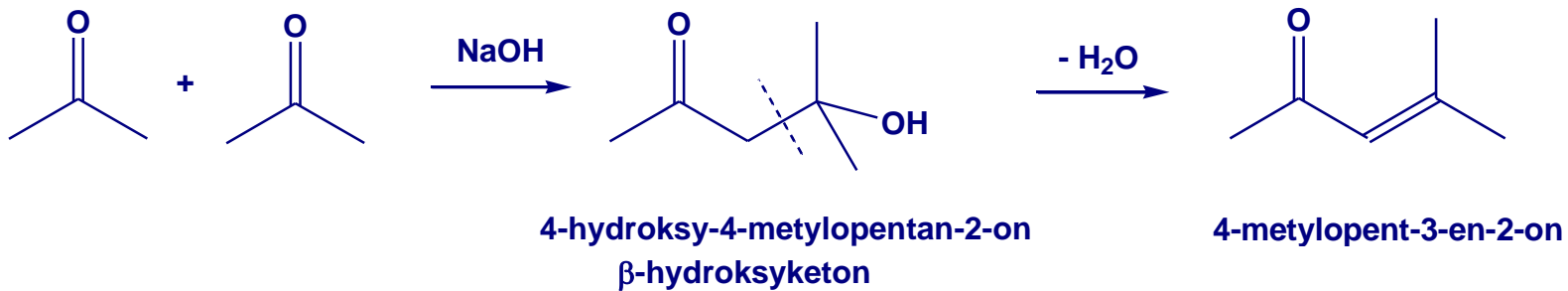
Tej reakcji ulegają  
aldehydy bez protonów  $\alpha$

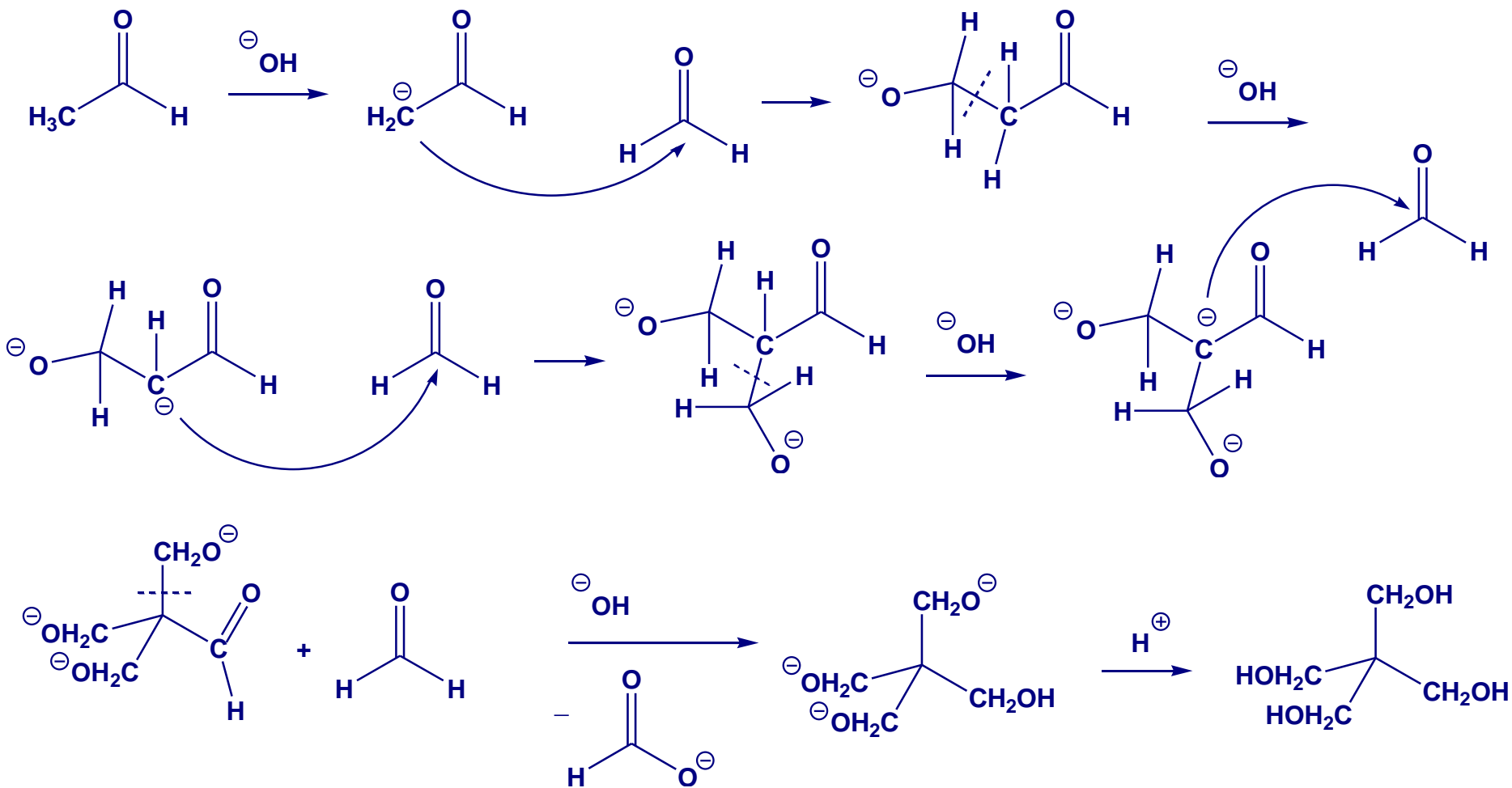
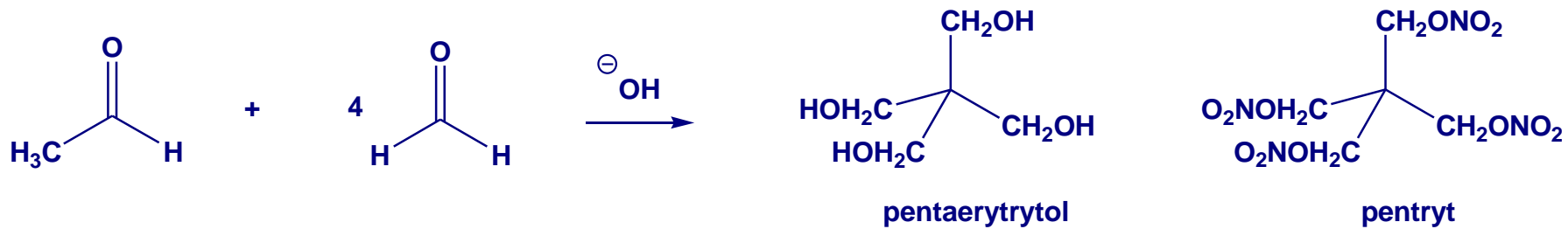


## Kondensacja aldolowa

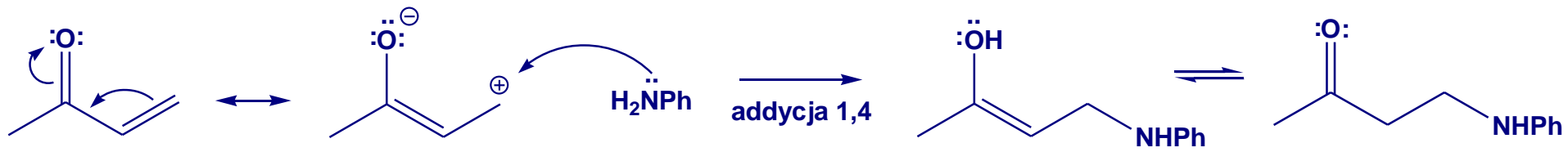
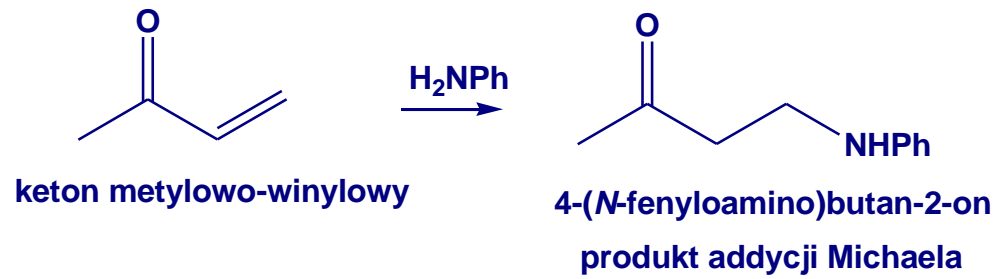
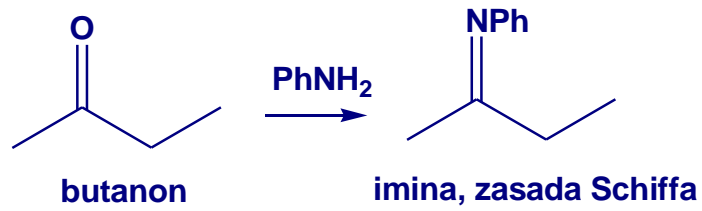
Tej reakcji ulegają  
aldehydy i ketony  
posiadające protony  $\alpha$



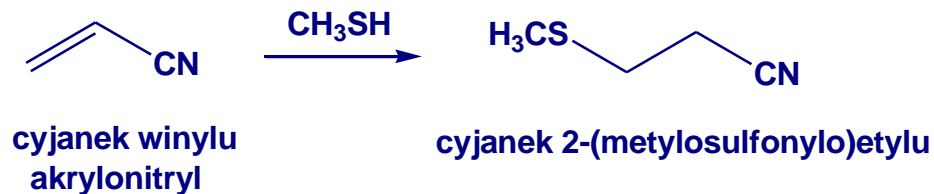




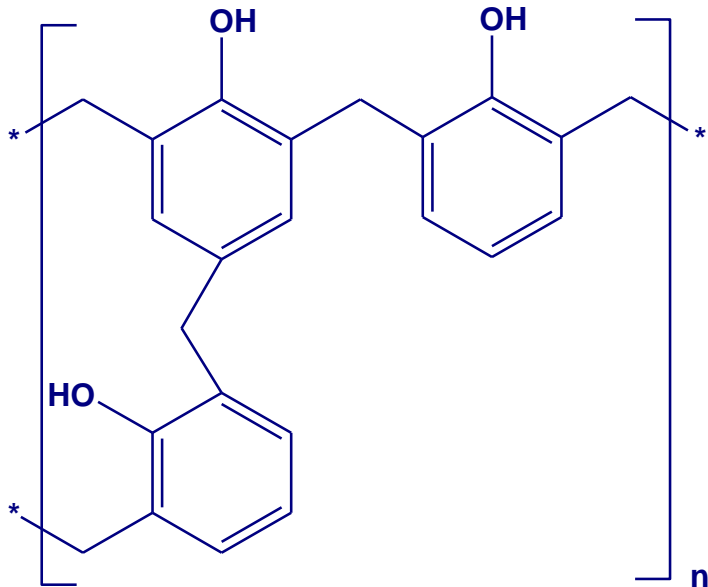
## Przykład reaktywności związku $\alpha,\beta$ -nienasyconego



Addycji Michaela ulegają związki  $\alpha,\beta$ -nienasycone z grupą o efekcie elektronoakceptorowym, np. aldehydową, ketonową, nitrową, karboksylową, cyjankową, sulfonową.



## Żywice formaldehydowo – fenolowe (bakelit)



Szerokie zastosowanie dzięki właściwościom izolacyjnym (słabe przewodnictwo elektryczne, cieplne), względnie dobra odporność chemiczna, tworzywo termoplastyczne (formowanie dowolnych kształtów).

