Sacharydy

- **Sacharydy, cukry, węglowodany** $C_n(H_2O)_n$
- Najczęściej występujące związki w organizmach żywych
- Powstają podczas **fotosyntezy** – endotermicznej reduktywnej kondensacji CO_2 w obecności światła i chlorofilu $n\ CO_2 + n\ H_2O + E \rightarrow C_nH_{2n}O_n + n\ O_2$

Rola :

✓funkcja zapasowa –

rośliny-

zwierzęta, ludzie –

✓ transportowa –

✓ budulcowa (celuloza, hemiceluloza, chityna)

- wchodzą w skład DNA, RNA
- modyfikacja niektórych białek
- hamują krzepnięcie krwi – heparyna

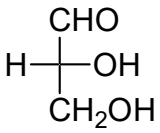
✓materiał energetyczny (fruktoza) i odżywczym (maltoza, laktoza, rafinoza).

Sacharydy - podział

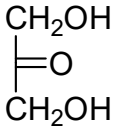
złożoność	Cukry proste monosacharydy		Cukry złożone ➢ Disacharydy ➢ Trisacharydy ➢ Oligosacharydy ➢ Polisacharydy	
Ilość at. węgla	Tetrozy (C4)	Pentozy (C5)	Heksozy (C6)	Heptozy (C7)
C=O grupa funkcyjna	**Aldozy** zawierają gr. aldehydową lub jej ekwiwalent		**Ketozy** zawierają gr. ketonową lub jej ekwiwalent	
reaktywność	Cukry reduktywne (reagują z odcz. Tollensa, Benedicta, Fehlingsa)		Cukry nie reduktywne (nie ulegają utlenianiu)	

Sacharydy

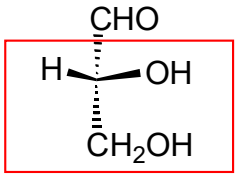
Najprostsze cukry



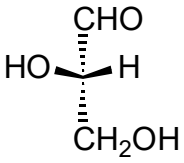
aldotrioza
2,3-dihydroksypropanal
(aldehyd glicerynowy)



ketotrioza
1,3-dihydroksypropanon
(1,3-dihydroksyaceton)

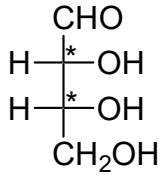


(*R*)-(+)- 2,3-dihydroksypropanal
D-(+)-aldehyd glicerynowy
$[\alpha]^{25}_{D} = +8.7^{o}$

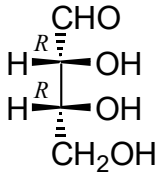


(*S*)-(-)- 2,3-dihydroksypropanal
L-(-)-aldehyd glicerynowy
$[\alpha]^{25}_{D} = -8.7^{o}$

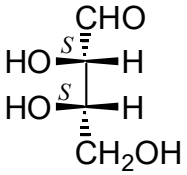
Sacharydy



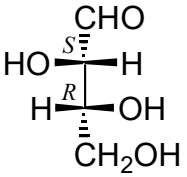
aldotetroza
2,3,4-trihydroksybutanal



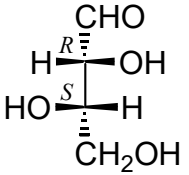
2R,3R
D-(-)-erytroza



2S,3S
L-(+)-erytroza

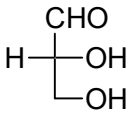


2S,3R
D-(-)-treoza

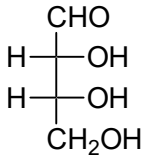


2R,3S
L-(+)-treoza

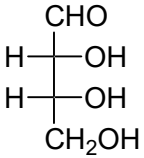
Sacharydy – aldozy D



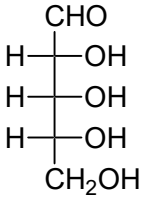
D-(+)-aldehyd glicerynowy



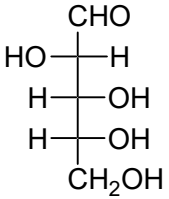
D-(-)-erytroza



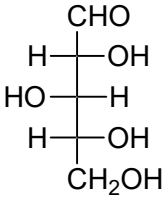
D-(-)-treoza



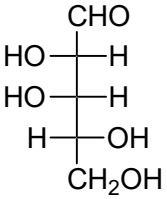
D-(-)-ryboza



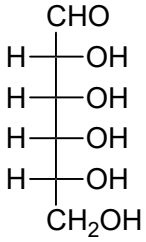
D-(-)-arabinoza



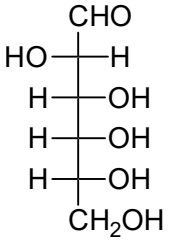
D-(+)-ksyloza



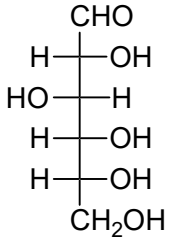
D-(-)-liksoza



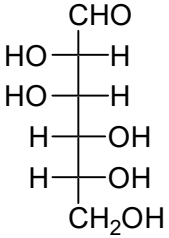
D-(+)-alloza



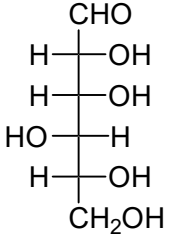
D-(+)-altroza



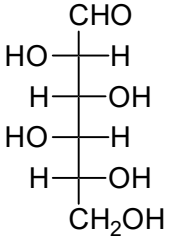
D-(+)-glukoza



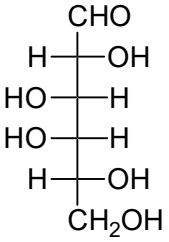
D-(+)-mannoza



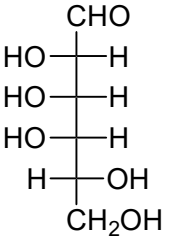
D-(-)-guloza



D-(-)-idoza

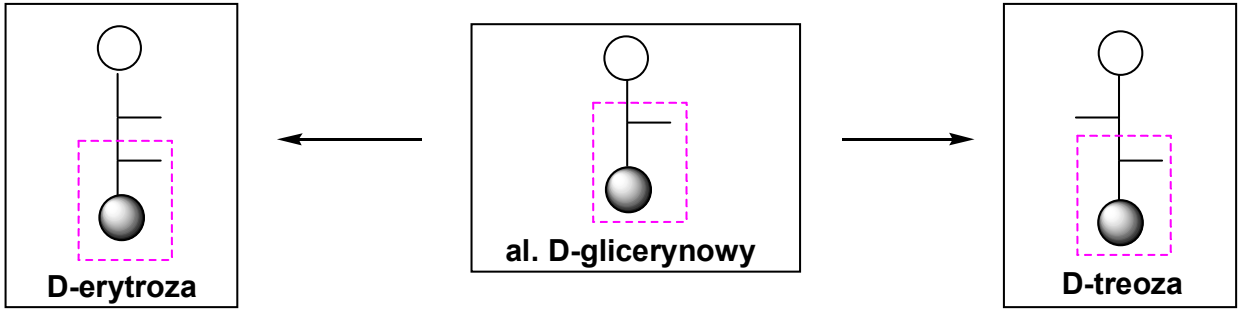


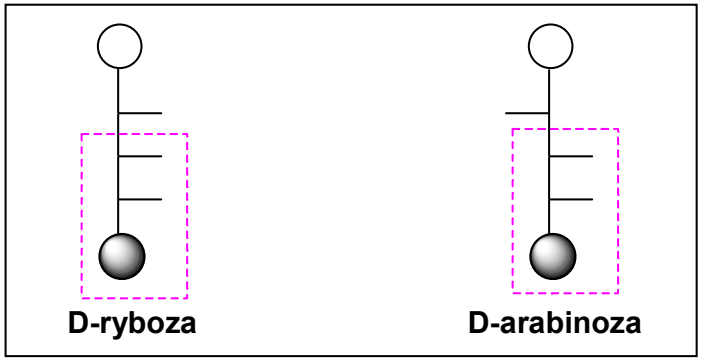
D-(+)-galaktoza

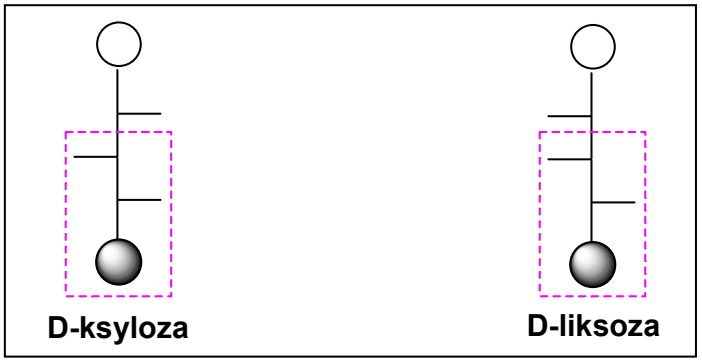


D-(+)-taloza

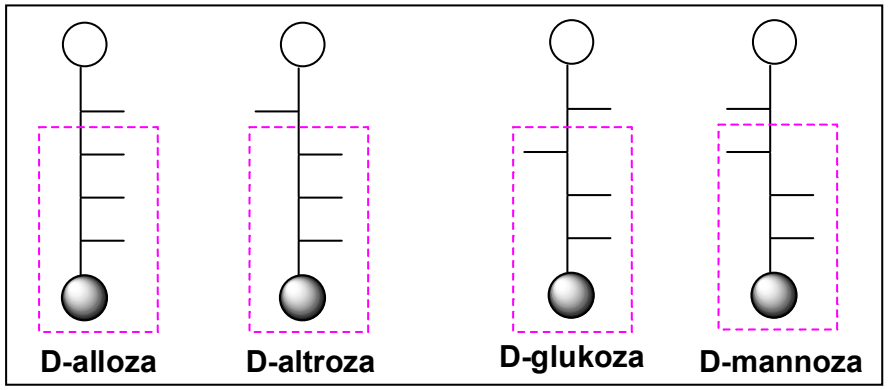
Sacharydy – schemat konfiguracyjny aldoz szeregu D

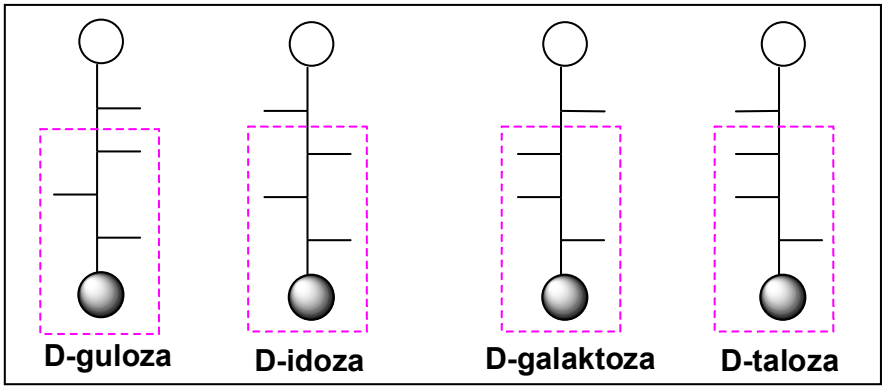






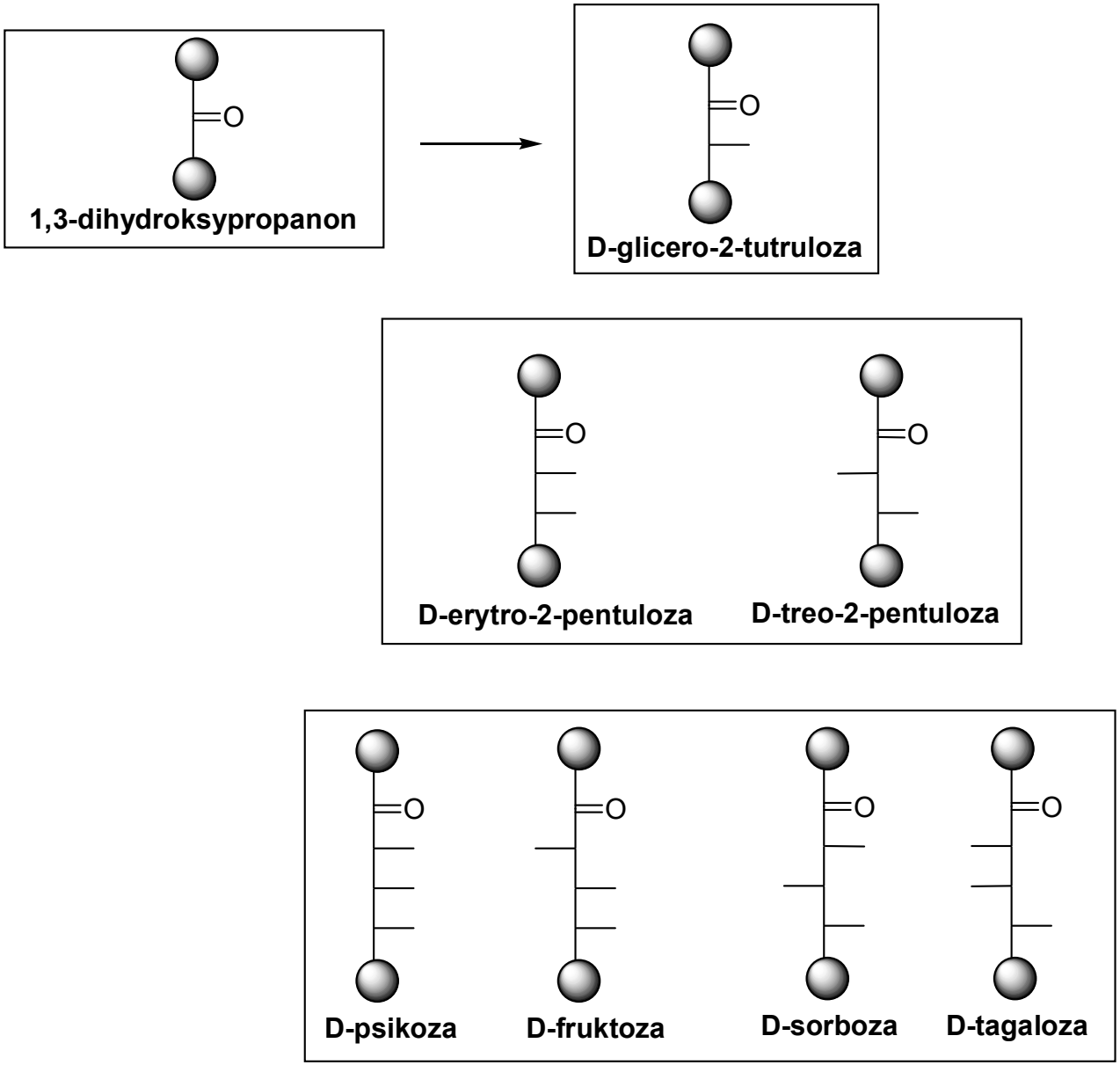
RAKL



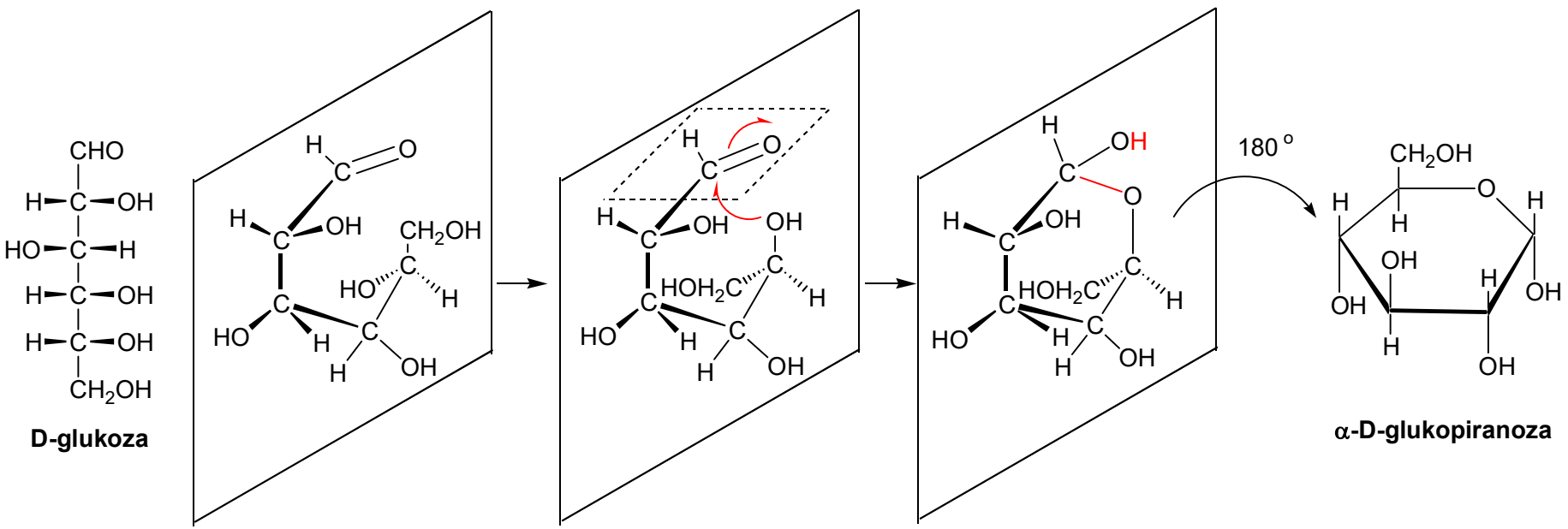


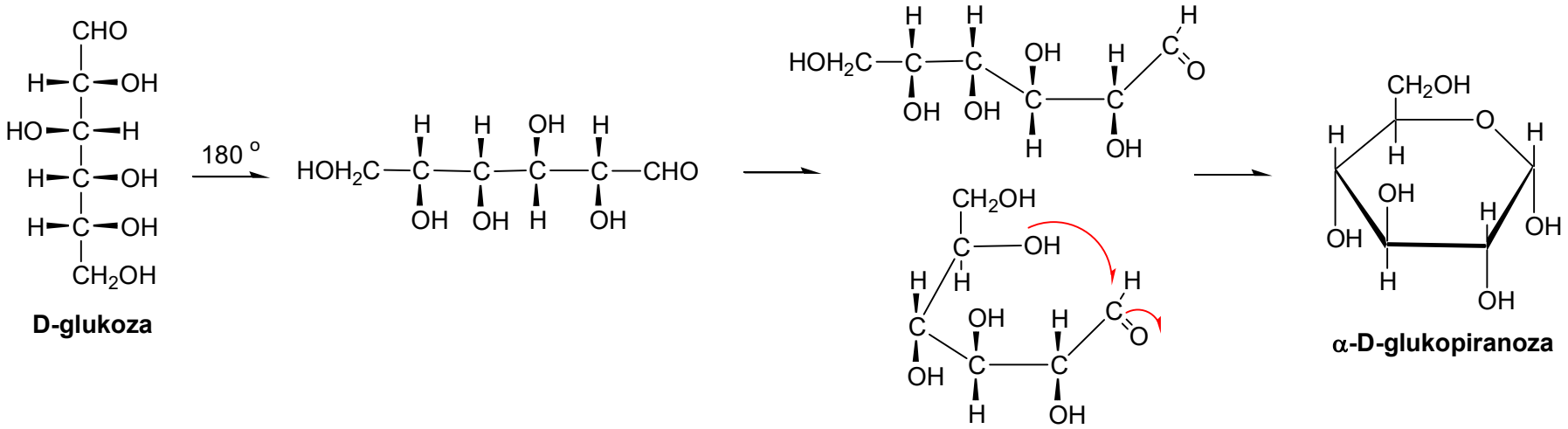
All altruists gladly make gumm in galon tanks

Sacharydy – schemat konfiguracyjny ketoz szeregu D

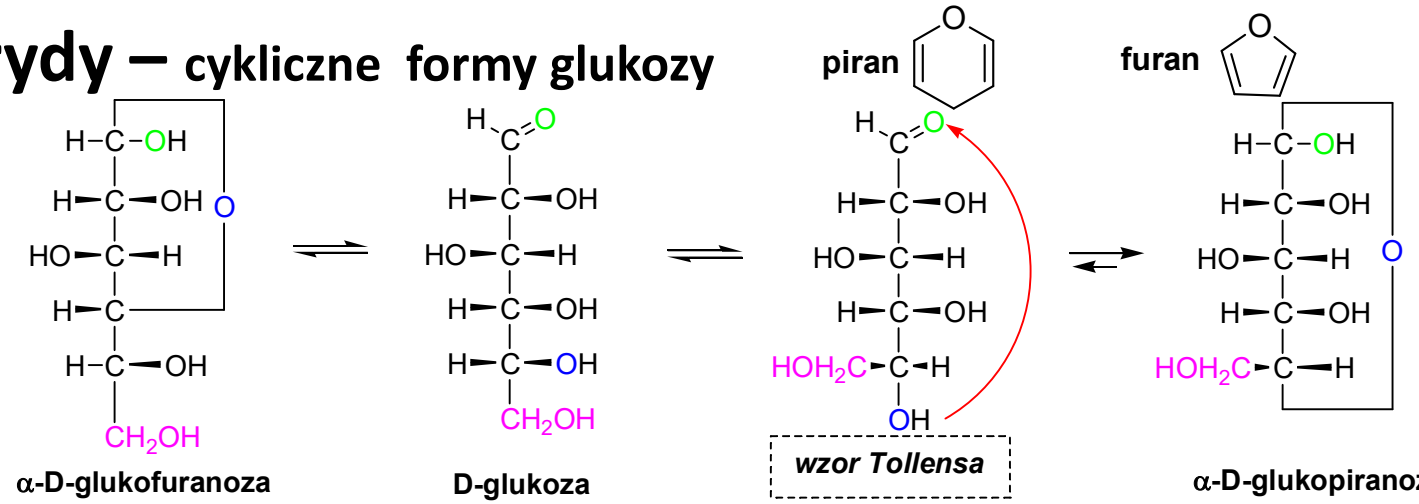


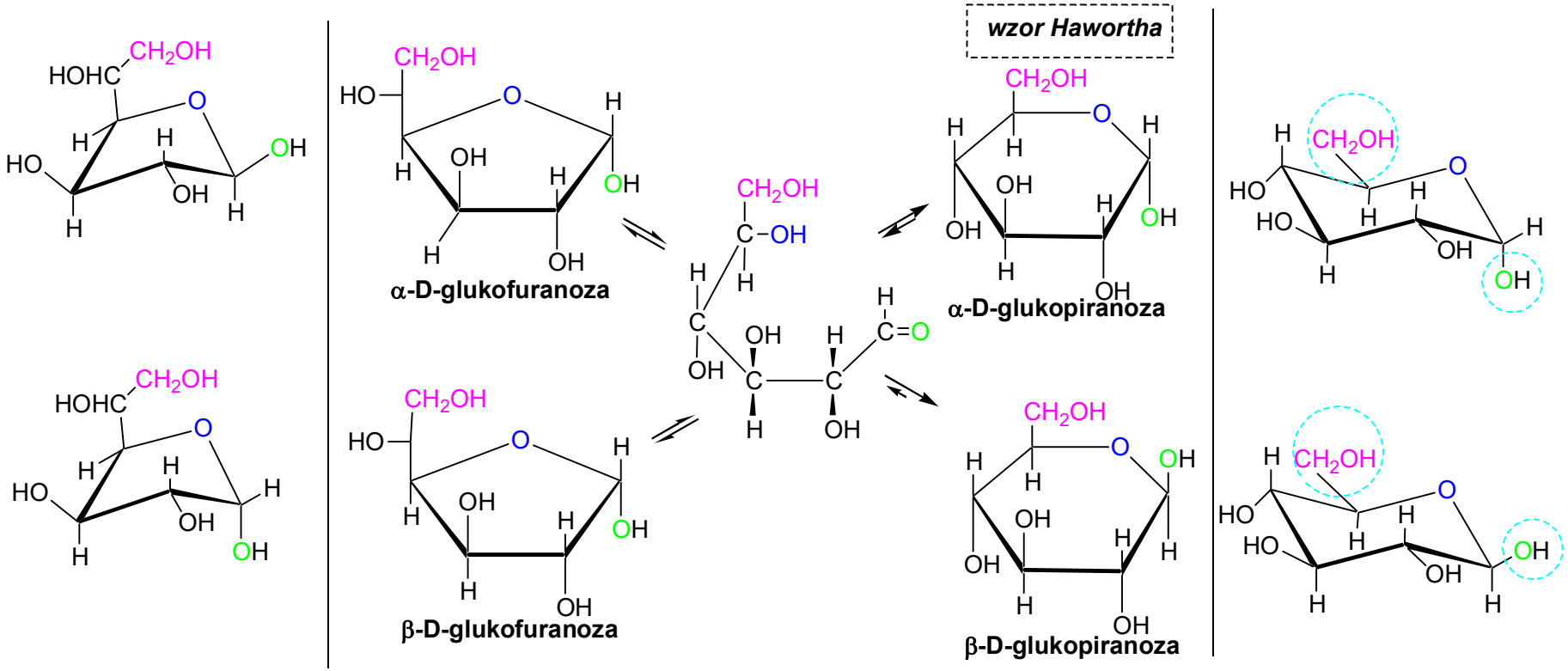
Sacharydy – tworzenie wewnątrzcząsteczkowego hemiacetalu





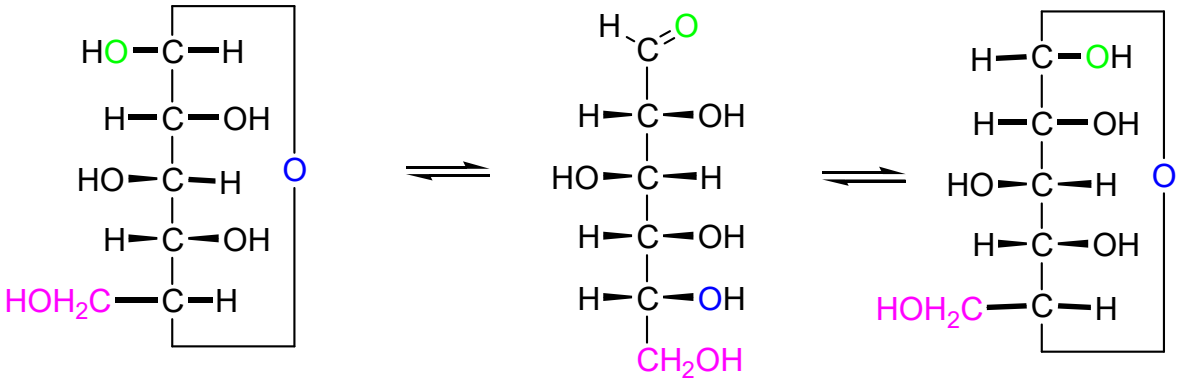
Sacharydy – cykliczne formy glukozy



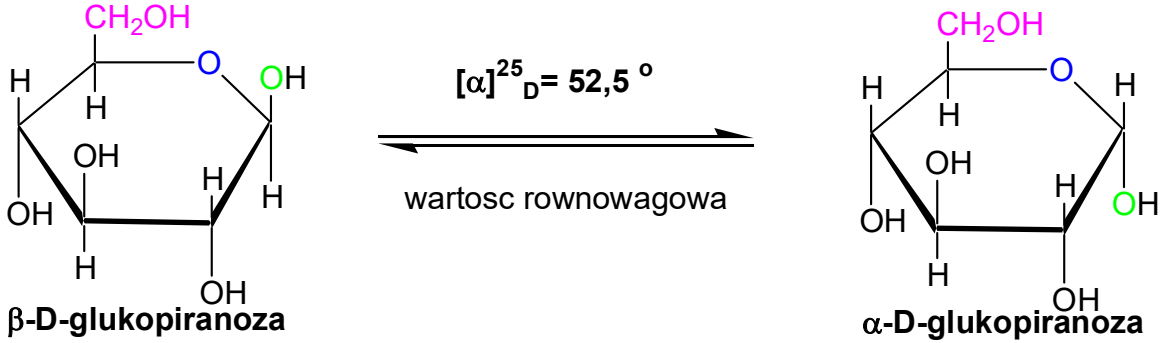


Sacharydy – cykliczne formy glukozy c.d.

mutarotacja



β-D-glukopiranoza | D-glukoza | α-D-glukopiranoza



β-D-glukopiranoza

[α]25D= 17,5 °

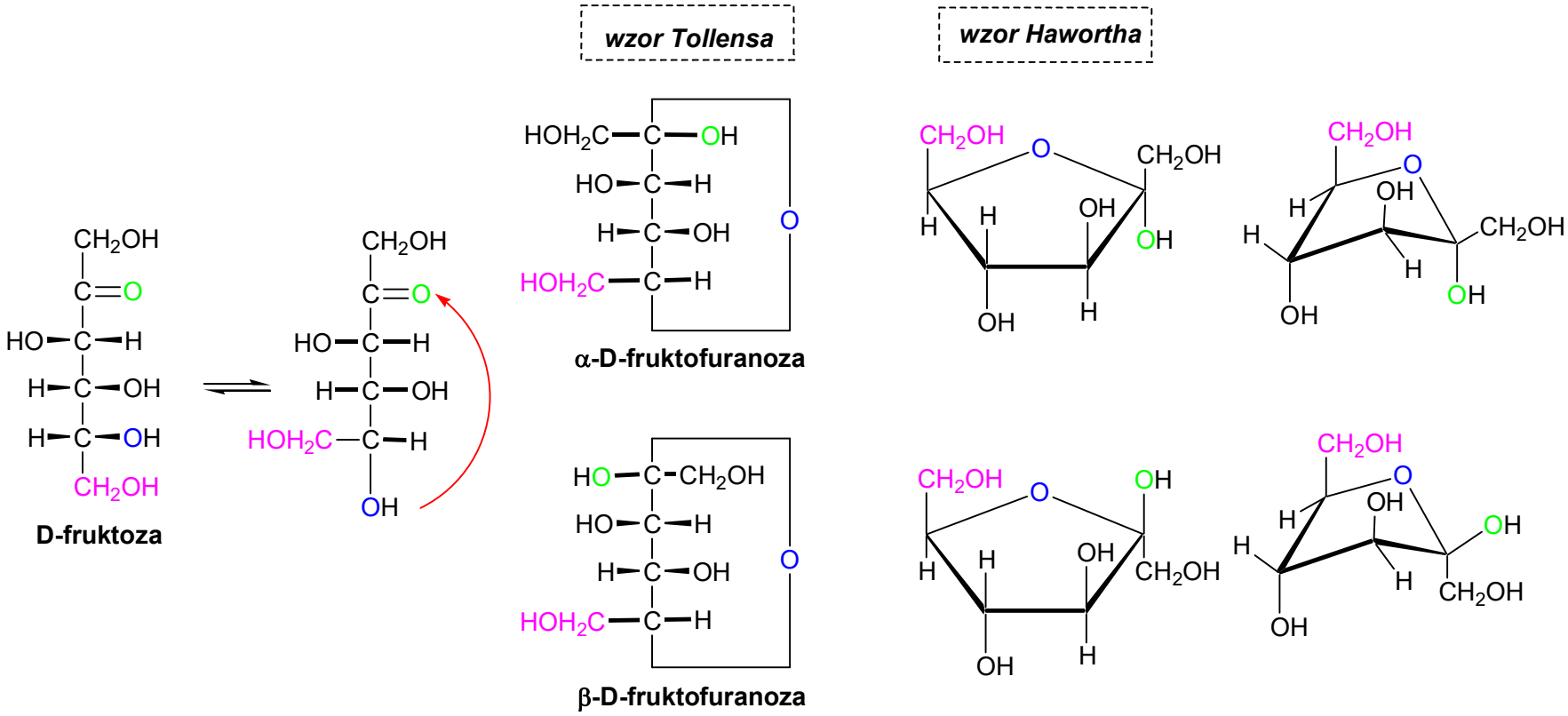
62%

α-D-glukopiranoza

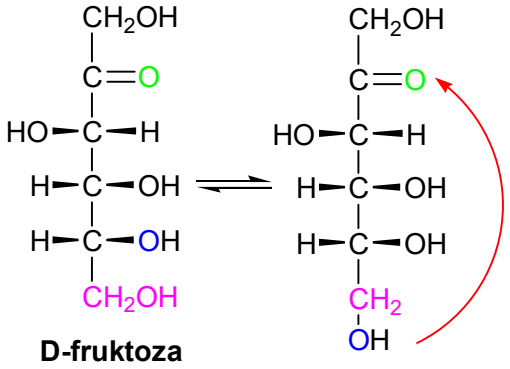
[α]25D= 111 °

38%

Sacharydy – cykliczne formy fruktozy

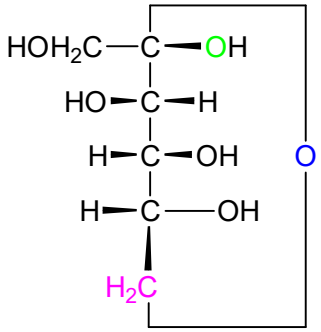


Sacharydy – cykliczne formy fruktozy c.d

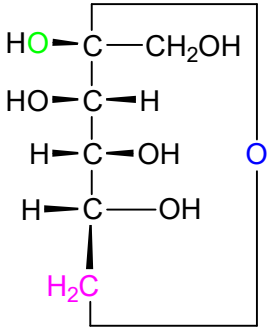


D-fruktoza

wzor Tollensa

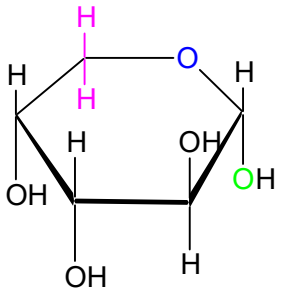


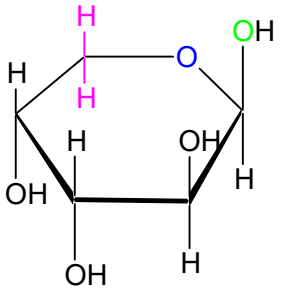
α-D-fruktopiranoza

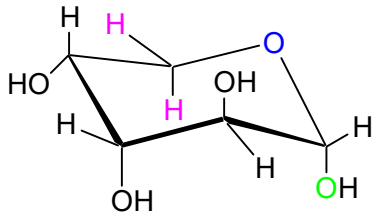


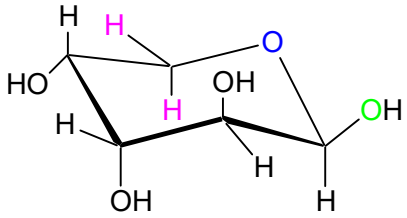
β-D-fruktopiranoza

wzor Hawortha







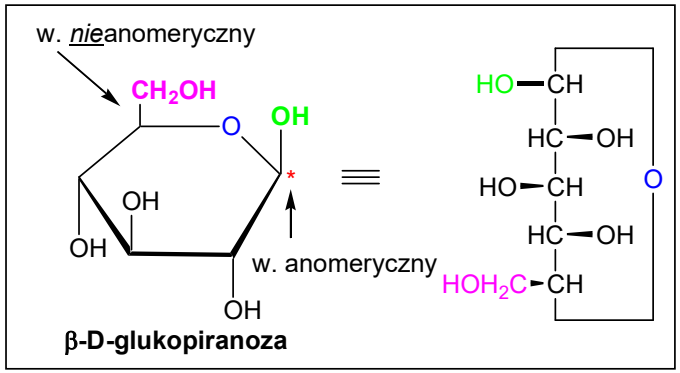


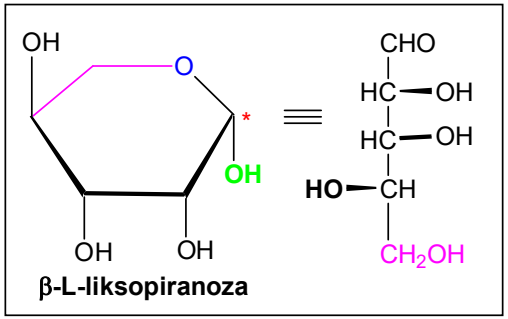
Sacharydy – tworzenie wewnątrzcząsteczkowego hemiacetalu - podsumowanie

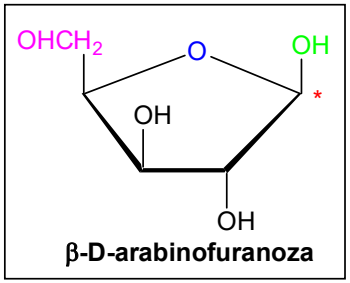
Szereg D –
Szereg L –

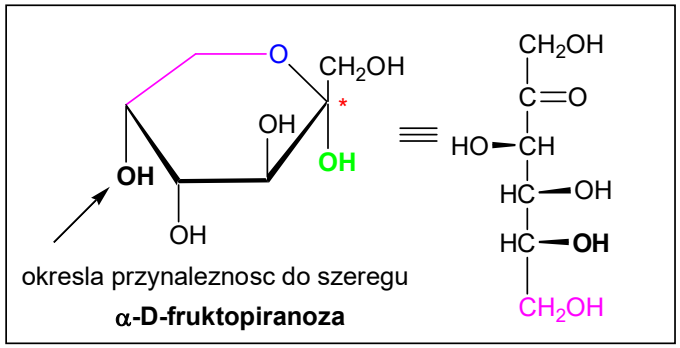
Anomer α –

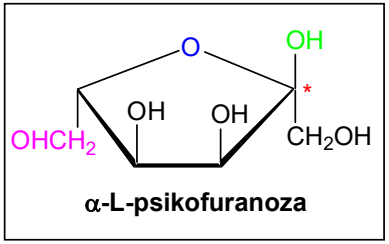
Anomer β -

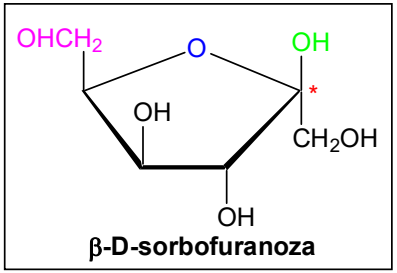






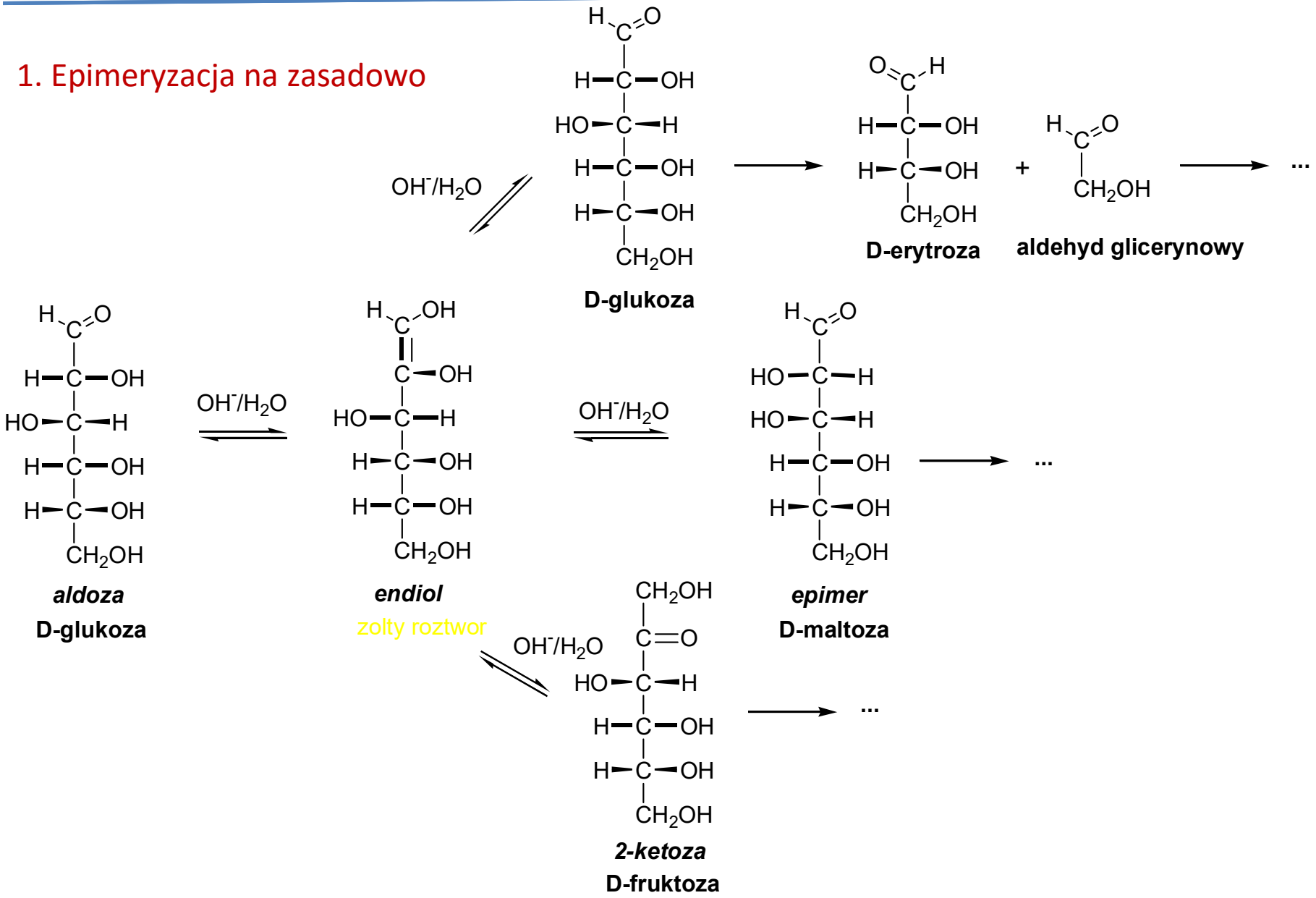






Sacharydy – reaktywność

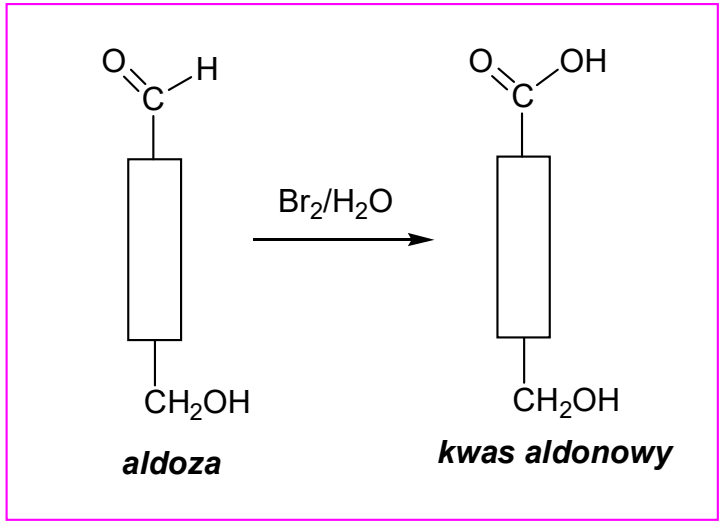
1. Epimeryzacja na zasadowo



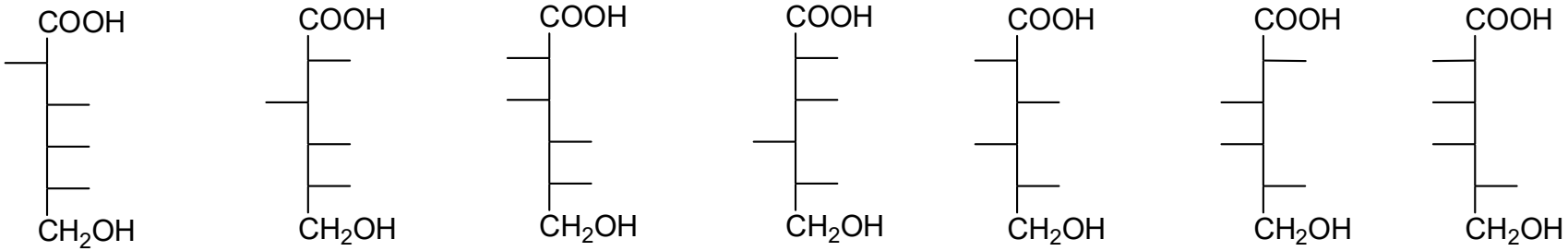
Sacharydy – reaktywność

2. Utlenianie

2.1. utlenianie gr. aldehydowej – *„cukry redukujące”*

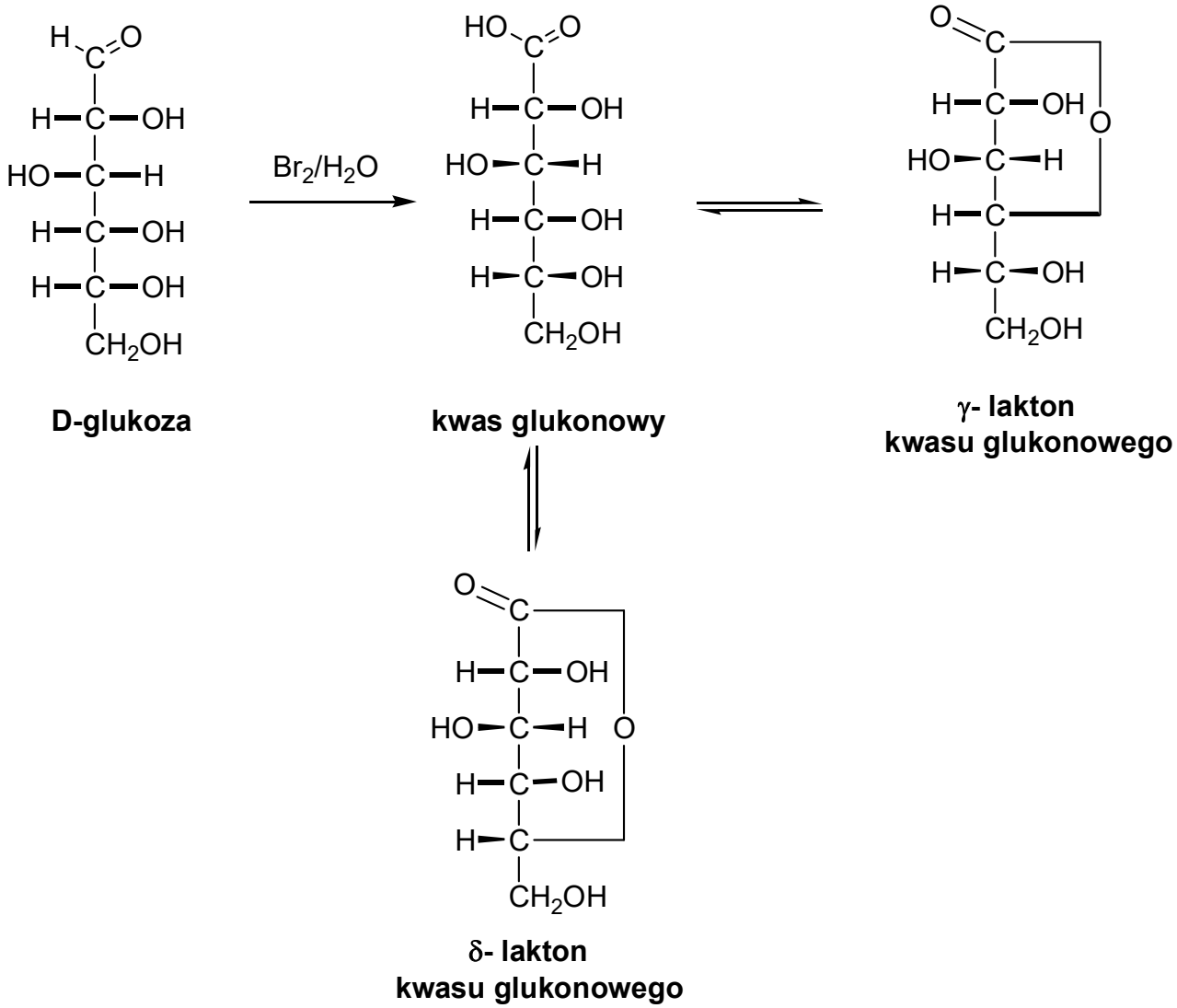


aldoza ***kwas aldonowy***



kwas altronowy **kwas glukonowy** **kwas mannonowy** **kwas gulonowy** **kwas indozowy** **kwas galaktonowy** **kwas idonowy**

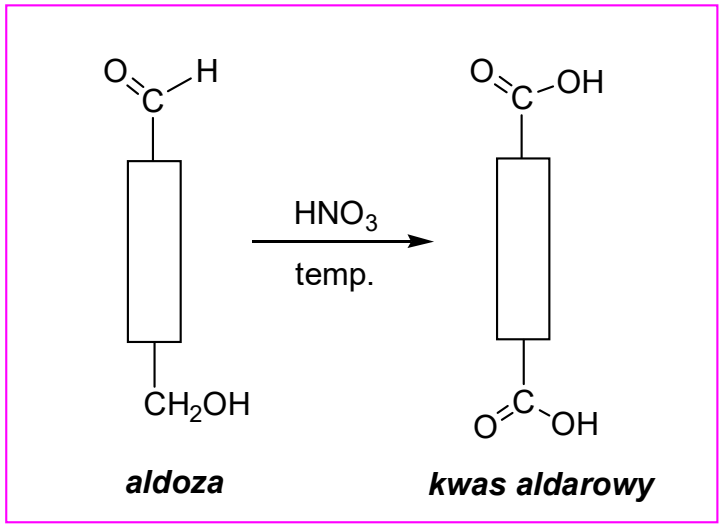
Sacharydy – utlenianie c.d



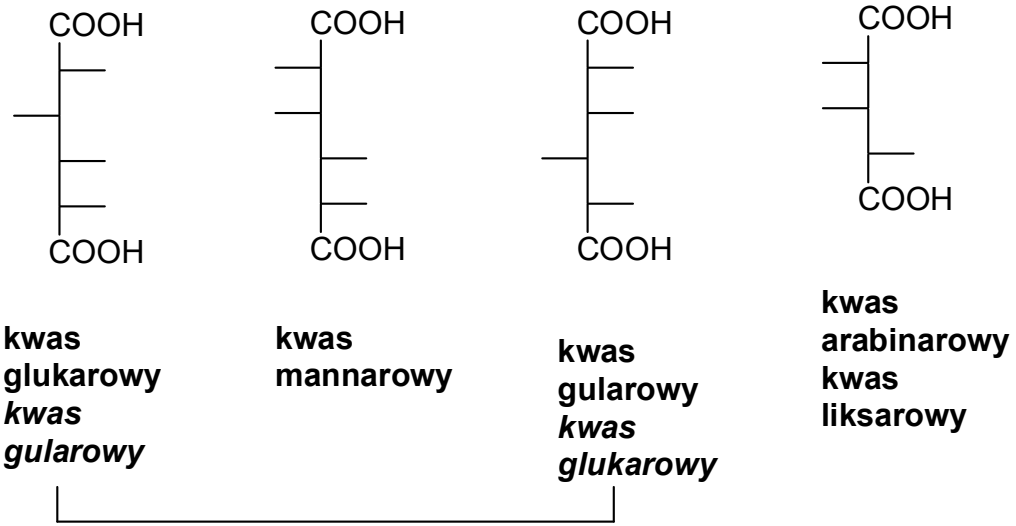
Sacharydy – reaktywność

2. Utlenianie

2.2. utlenianie gr. aldehydowej
+ terminalnej gr. hydroksylowej



aldoza ***kwas aldarowy***



kwas glukarowy *kwas gularowy*

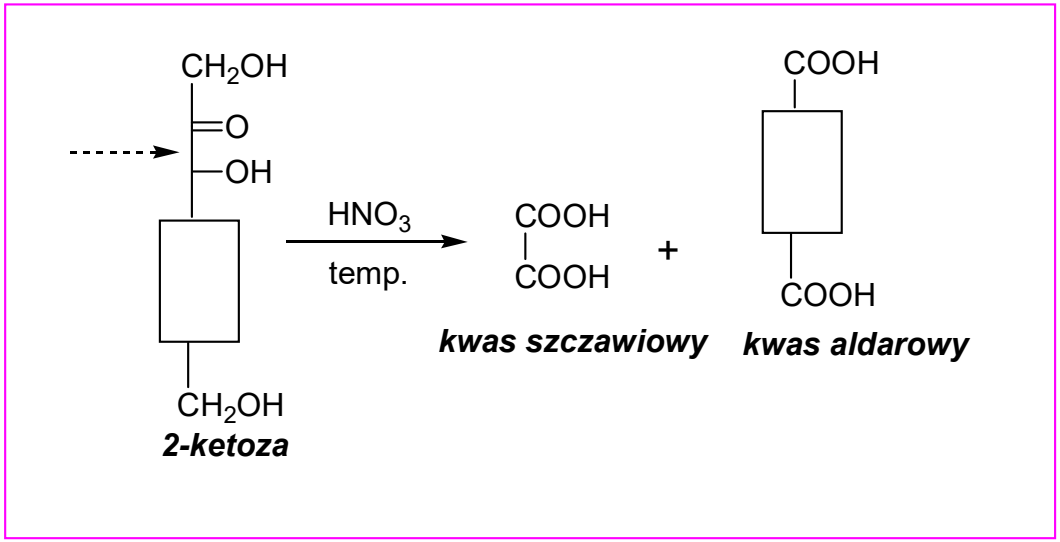
kwas mannarowy

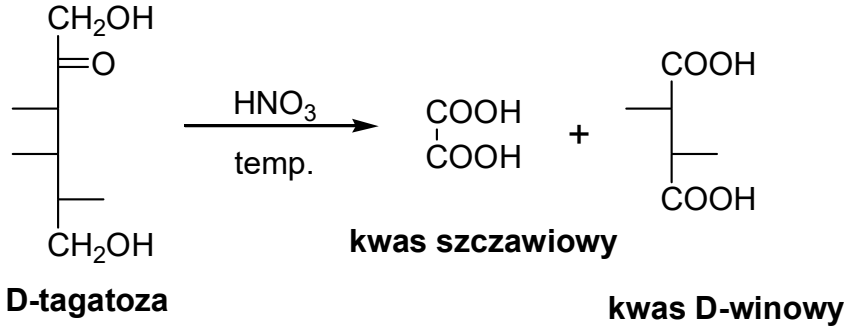
kwas gularowy *kwas glukarowy*

kwas arabinarowy kwas liksarowy

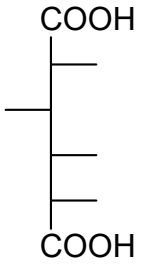
Sacharydy – reaktywność

Redukcja ketoz

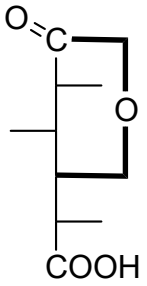




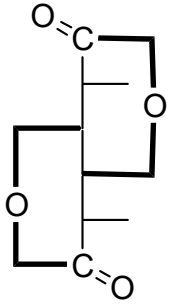
Sacharydy – reaktywność



kwas glukarowy

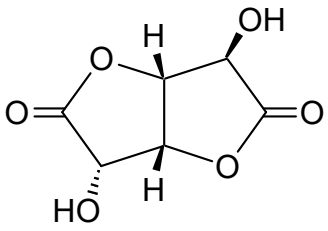


γ-lakton kwasu glukarowego



γ,γ-dilakton kwasu glukarowego

|||



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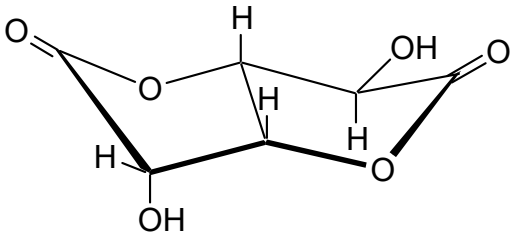
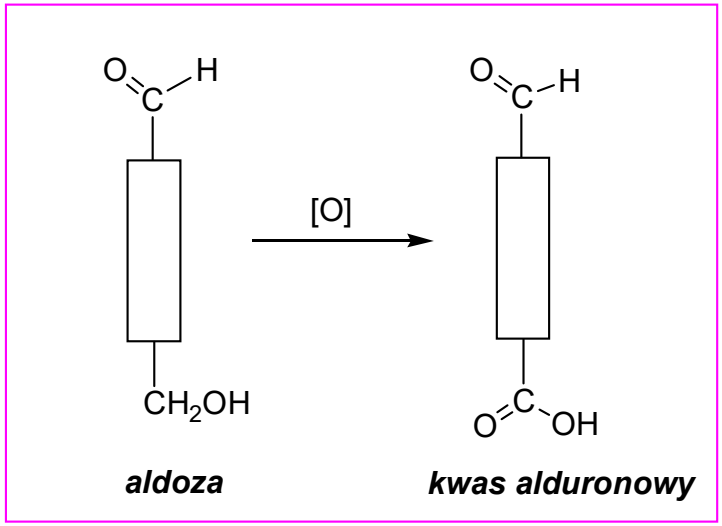


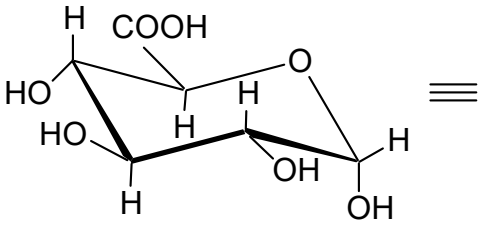
Sacharydy – reaktywność

2. Utlenianie

Kwasy uronowe



aldoza ***kwas alduronowy***



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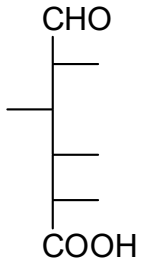
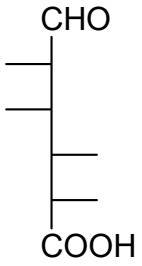
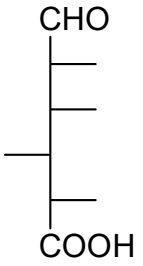


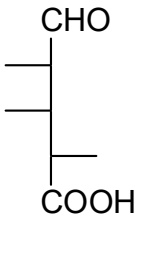
kwas glukuronowy



kwas mannuronowy



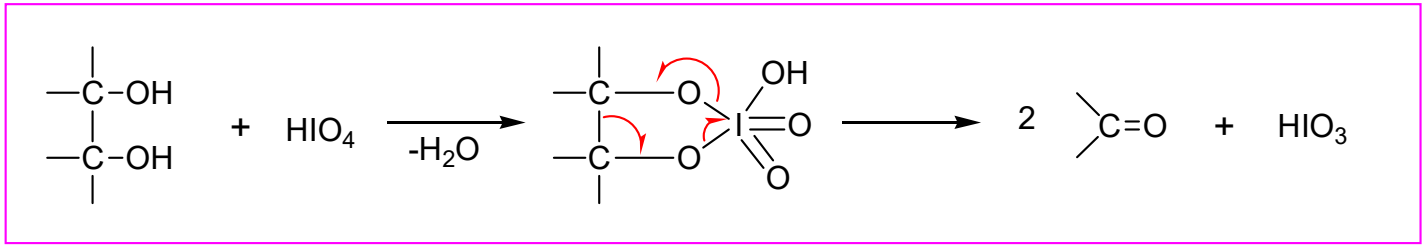
kwas gularunowy

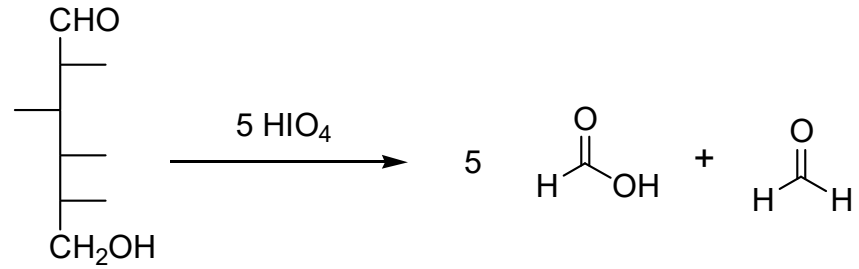


kwas arabinuronowy

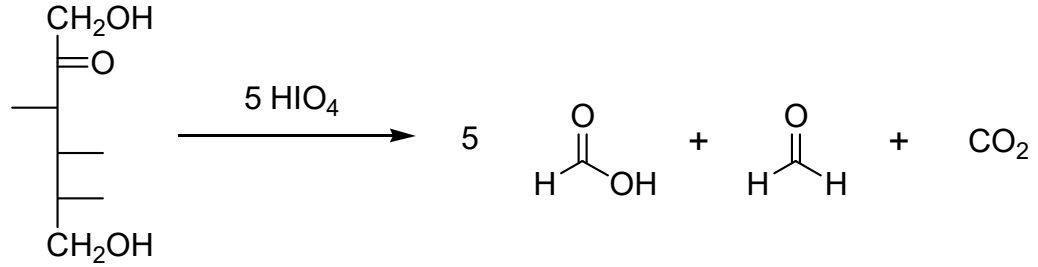
Sacharydy – reaktywność

2. Utlenianie





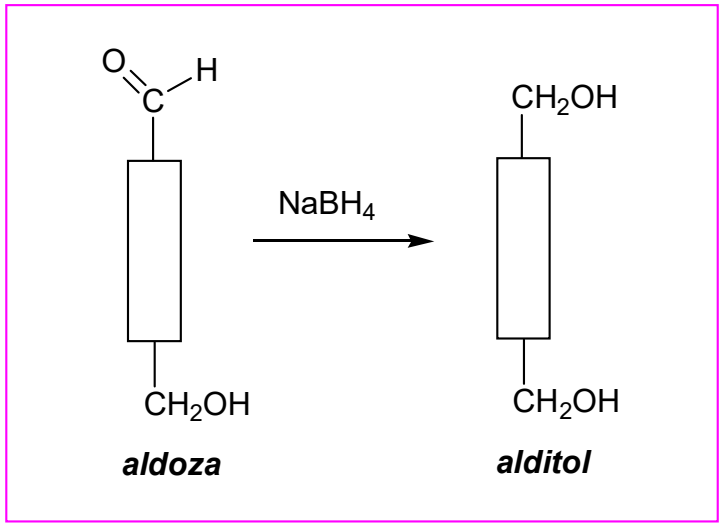
D-glukoza

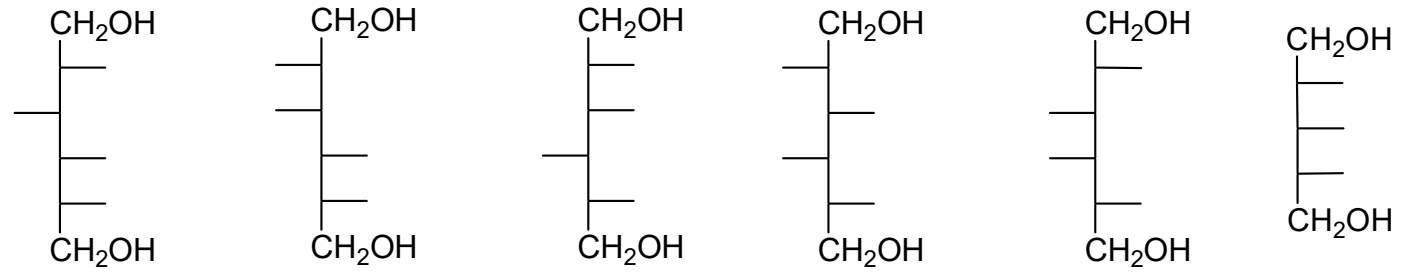


D-fruktoza

Sacharydy – reaktywność

3. Redukcja

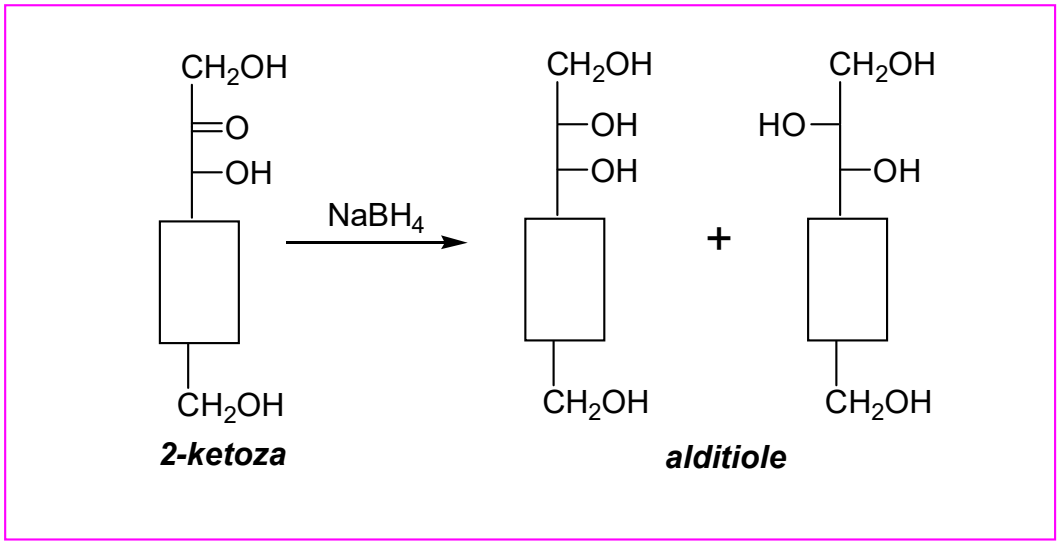


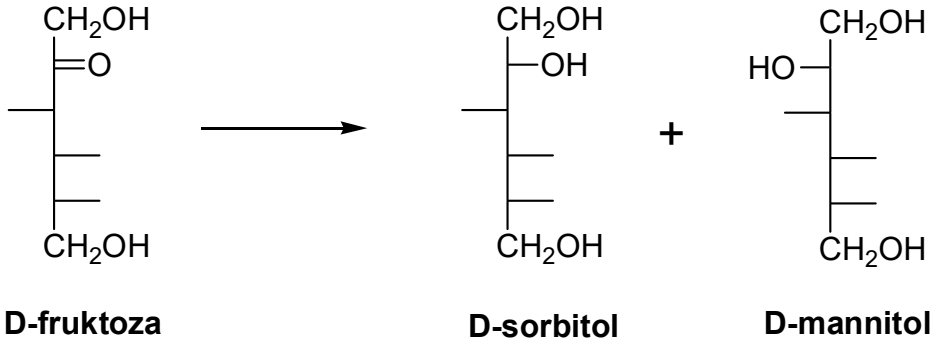


D-glucitol (D-sorbitol) | **D-mannitol** | **D-gulitol L-glucytol** | **D-indozytol** | **galaktitol** | **D-rybitol**

Sacharydy – reaktywność

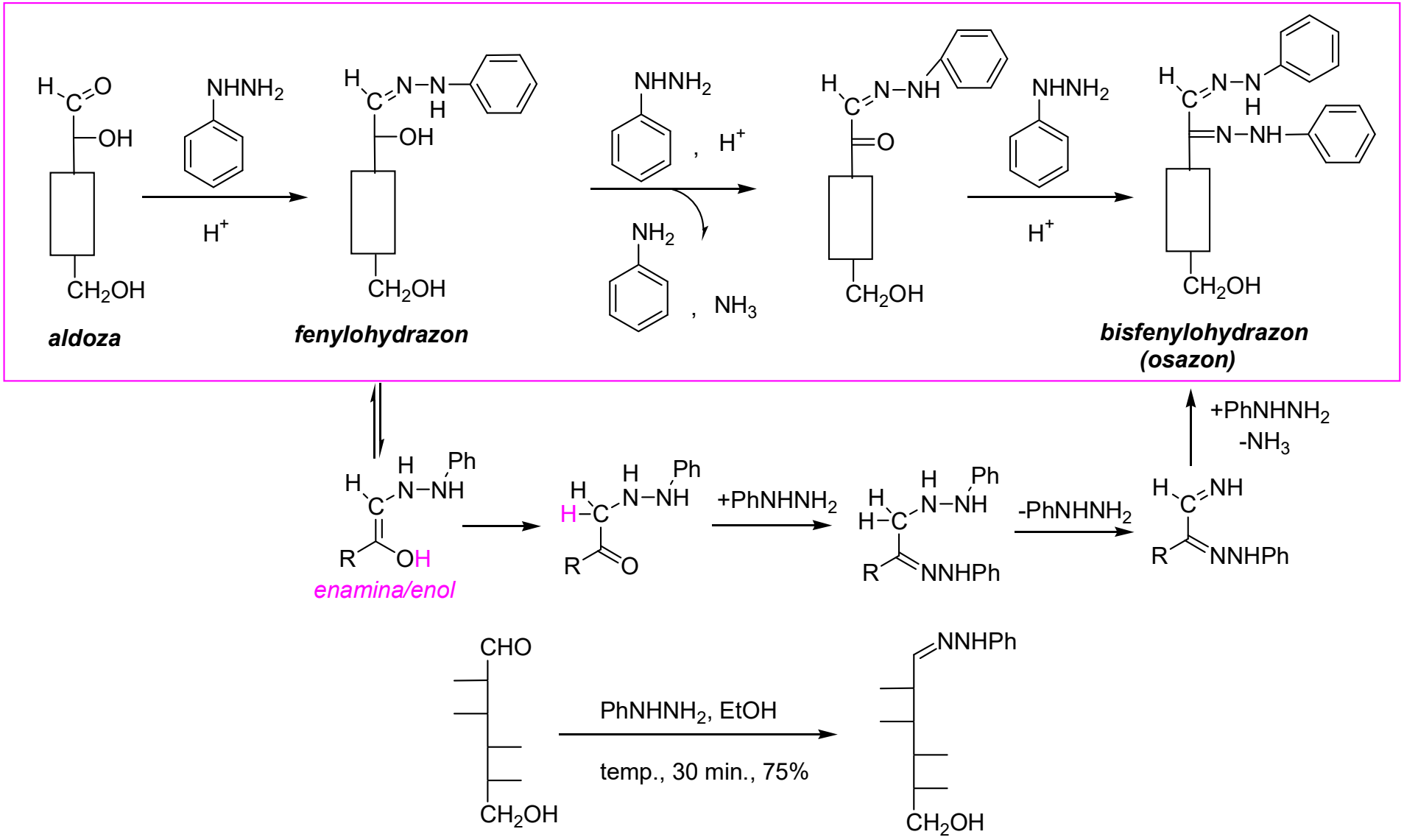
3. Redukcja



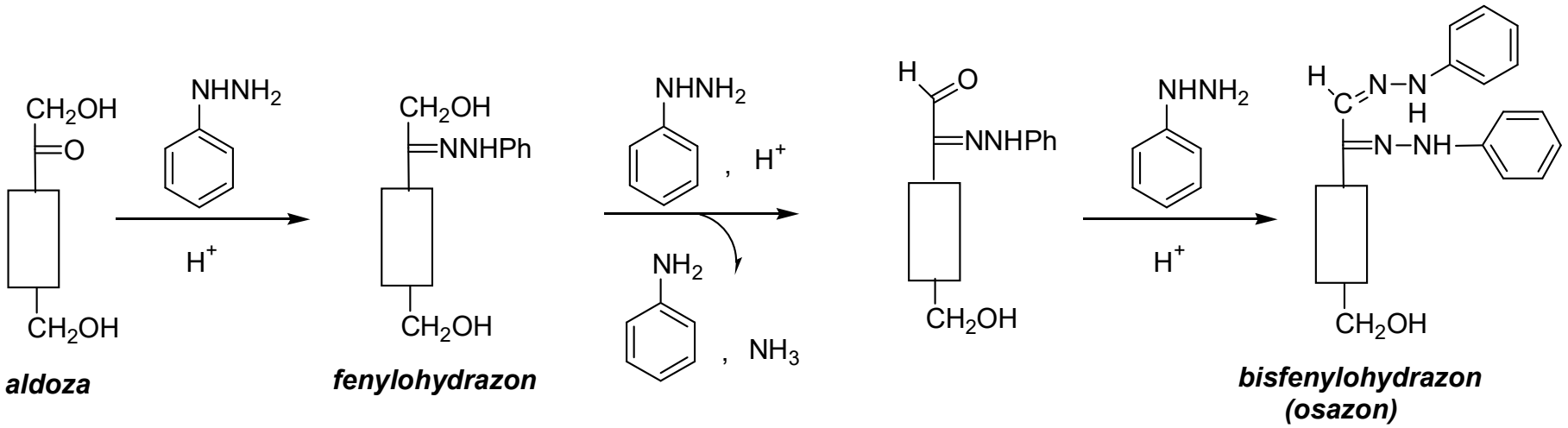


Sacharydy – reaktywność

4. Tworzenie oksazonów



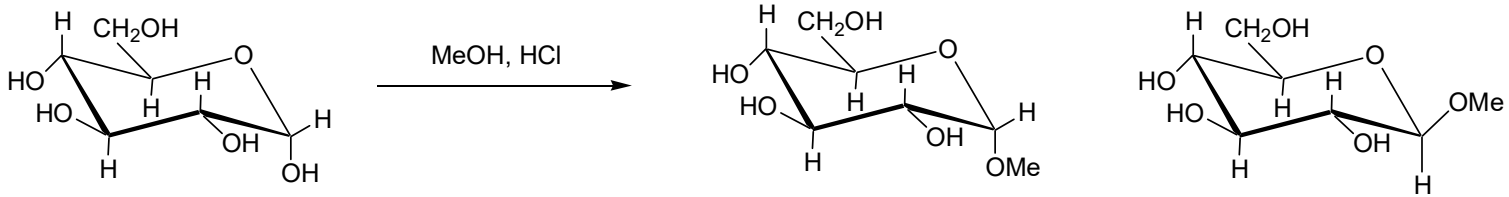
Sacharydy – reaktywność



aldoza ***fenylohydrazon*** ***bisfenylohydrazon (osazon)***

Sacharydy – reaktywność

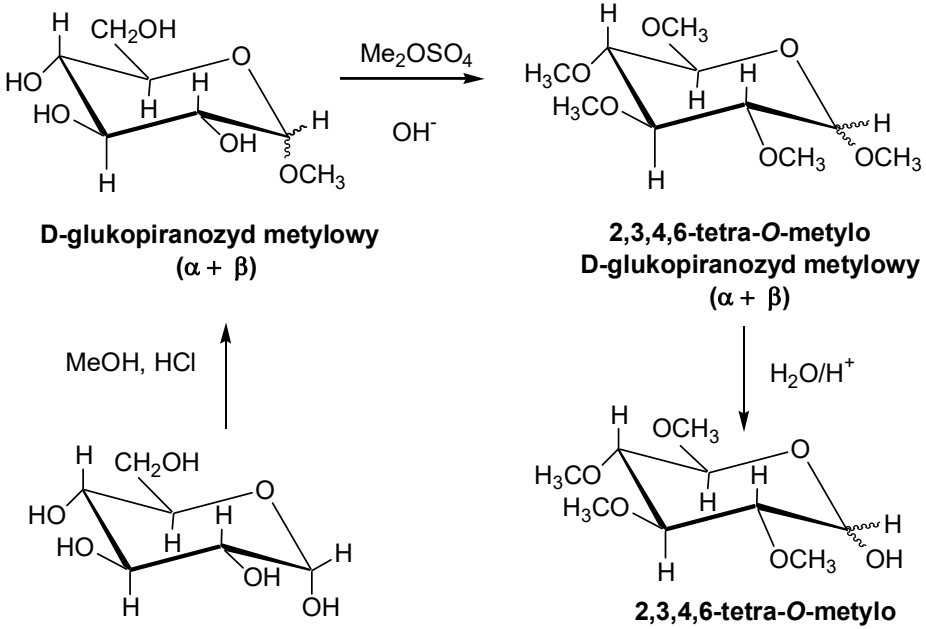
4. Tworzenie glikozydów



α-D-glukopiranozyd metylowy **β-D-glukopiranozyd metylowy**

nie ulegają mutarotacji !

5. metylowanie–



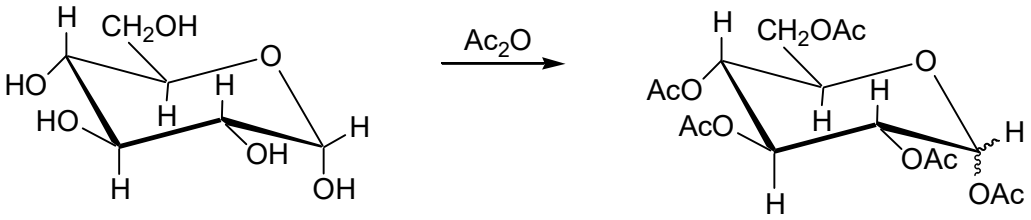
D-glukopiranozyd metylowy (α + β)

2,3,4,6-tetra-*O*-metylo D-glukopiranozyd metylowy (α + β)

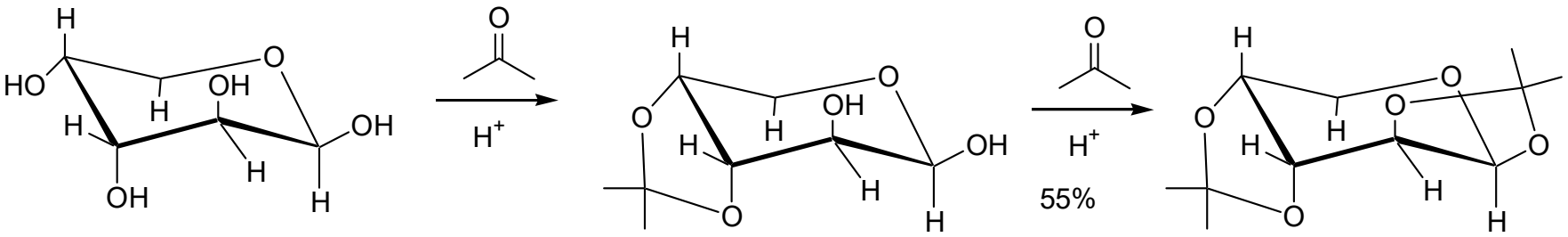
2,3,4,6-tetra-*O*-metylo D-glukopiranoza (α + β)

Sacharydy – reaktywność

6. Acetylowanie



6. Cykliczne acetale



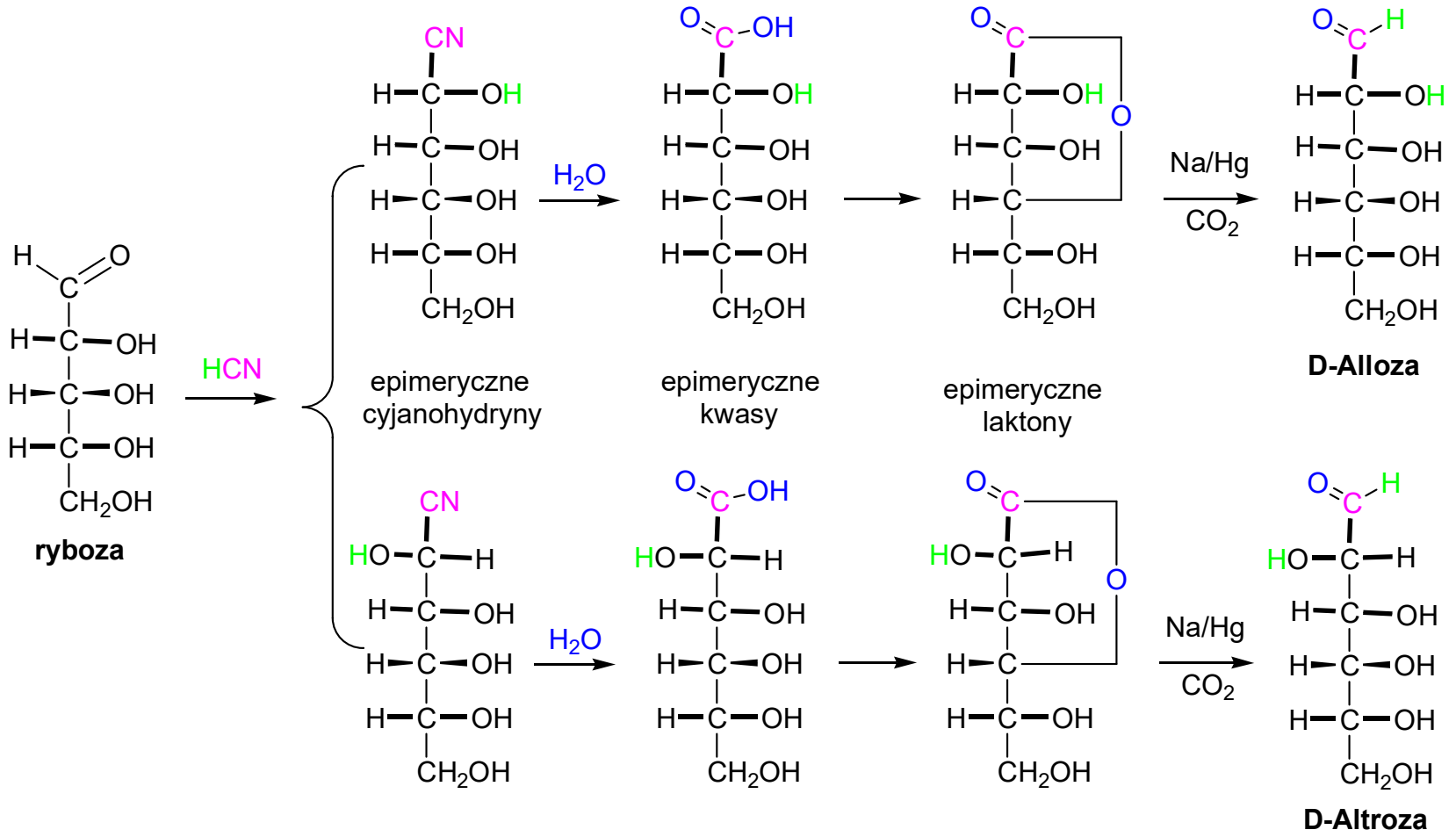
β-D-arabinopiranoza

monoacetal
β-D-arabinopiranozy

podwójny monoacetal
β-D-arabinopiranozy

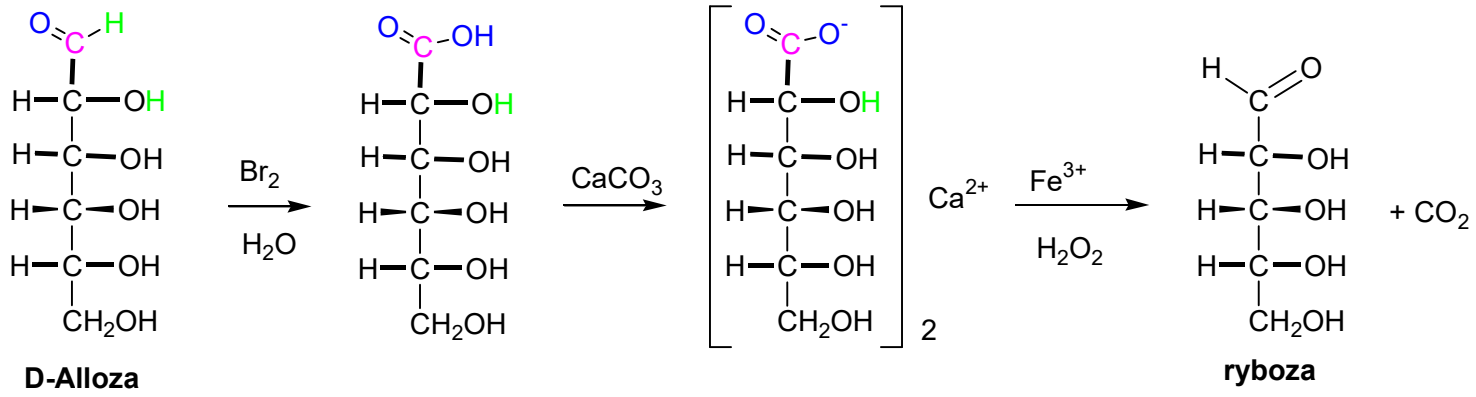
Sacharydy – reaktywność

7. Przedłużanie łańcucha aldoz – metoda Kilianiego



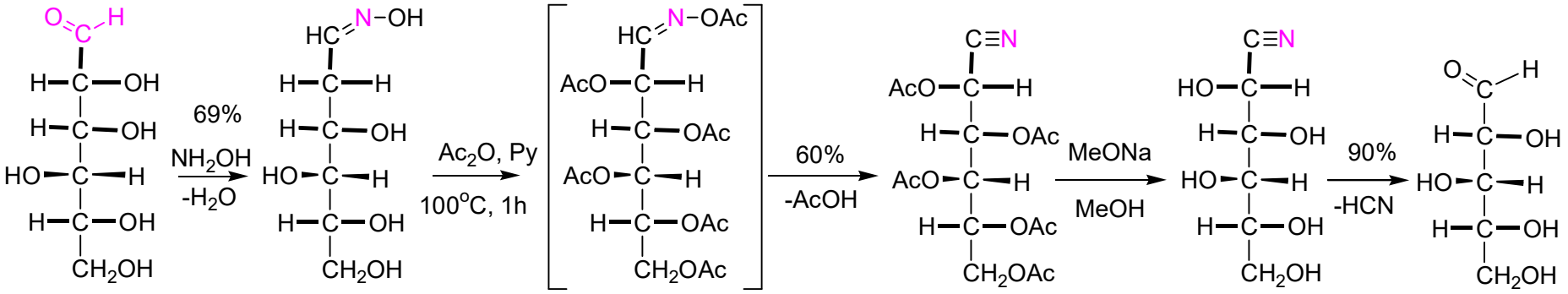
Sacharydy – reaktywność

8. 1. Skracanie łańcucha aldoz – metoda Ruffa



D-Alloza **ryboza**

8. 2. Skracanie łańcucha aldoz – metoda Wohl'a



D-Guloza oksym gulozy cyjanohydryna D-ksylozy **D-ksyloza**