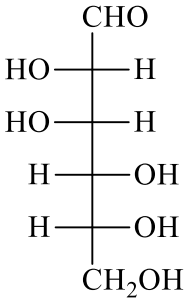
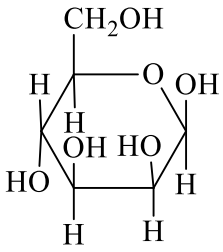
Marks 6

- The open chain form of D-mannose has the structure shown.

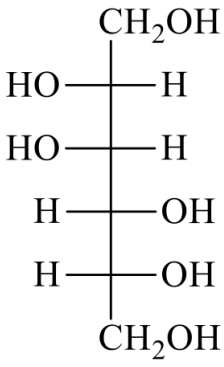


Draw the Haworth projection of β-D-mannopyranose.

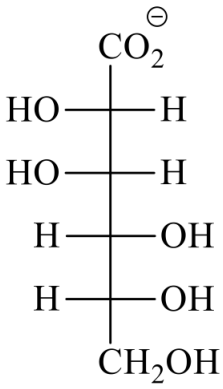


Draw the major organic product of the reaction of D-mannose with the following reagents.

1. $NaBH_4$ 2. $H^{\oplus}$ / H_2O



$[Ag(NH_3)_2]^{\oplus}$ / $OH^{\ominus}$

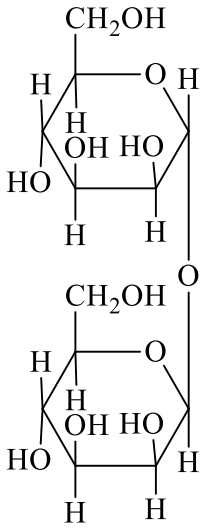


What is a reducing sugar?

A sugar that reduces Tollens' or Fehling's reagent. Sugars containing aldehyde or hemiacetal groups are reducing sugars.

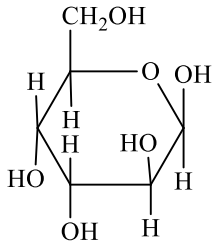
ANSWER CONTINUES ON THE NEXT PAGE

Give the Haworth formula of a non-reducing disaccharide that yields D-mannose as the only product on acid hydrolysis.

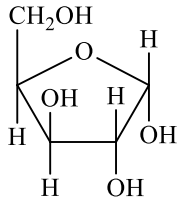


Marks 6

- Consider the following two monosaccharides, (**A**) and (**B**).



(**A**)

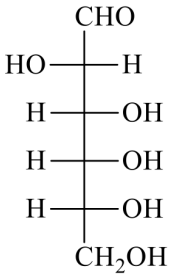


(**B**)

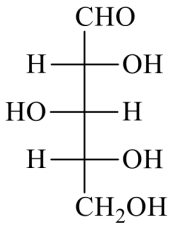
β-D-altropyranose α-D-xylofuranose

Draw Fischer projections of the open chain forms of (**A**) and (**B**).

(**A**)

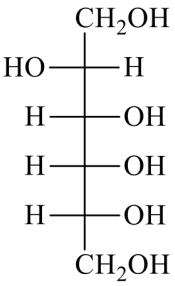


(**B**)

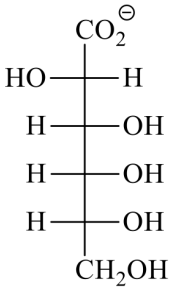


Draw the major organic product of the reaction of D-altropyranose with the following reagents.

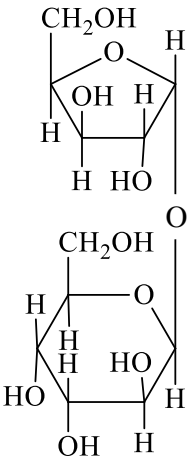
1. $NaBH_4$ 2. $H^{\oplus}$ / H_2O



$[Ag(NH_3)_2]^{\oplus}$ / $OH^{\ominus}$



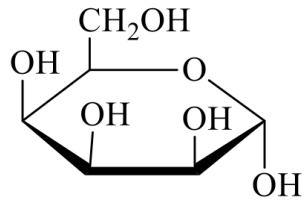
Draw the Haworth stereoformula of a non-reducing disaccharide formed from (**A**) and (**B**).

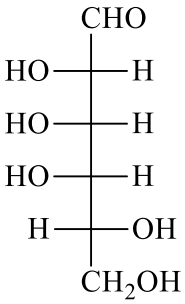


Marks 7

- The open chain form of D-talose is in equilibrium with two pyranose forms (**L**) and (**M**). Draw Haworth projections of (**L**) and (**M**).

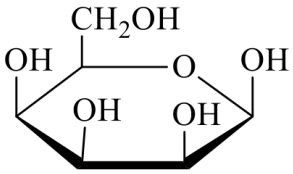
(**L**)



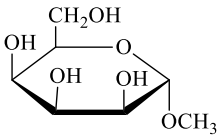


D-talose

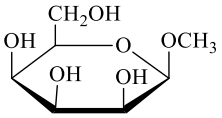
(**M**)



Give the Haworth stereoformula of one of the products obtained when D-talose is treated with excess methanol in the presence of an acid catalyst.

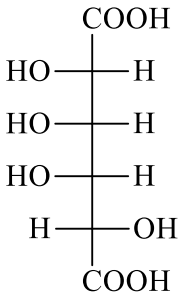


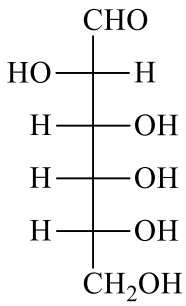
or



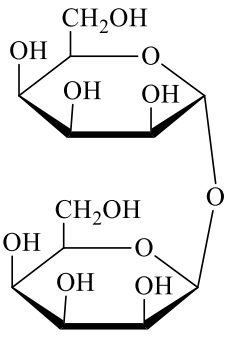
Concentrated HNO_3 oxidises aldehydes and primary alcohols to carboxylic acids, but does not oxidise secondary alcohols. Treatment of either D-talose or the aldohexose D-altrose with concentrated HNO_3 gives the diacid (**N**). Give the Fischer projection of D-altrose.

(**N**)



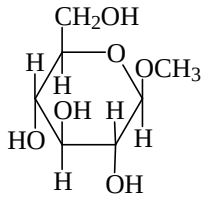


Draw the Haworth stereoformula of a non-reducing disaccharide formed from D-talose.

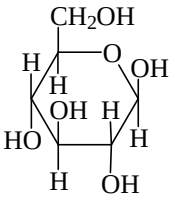


Marks 8

- Consider the following two monosaccharides, (**L**) and (**M**).



(**L**)



(**M**)

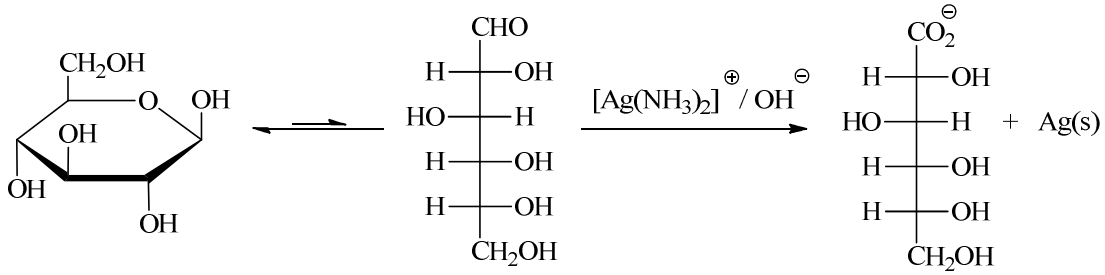
methyl β-D-glucopyranoside

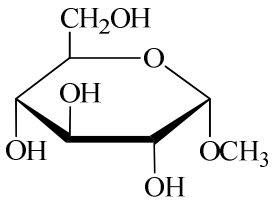
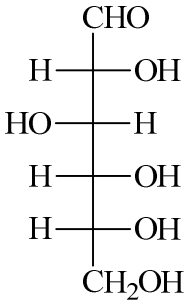
β-D-glucopyranose

Describe a chemical test that could be used to distinguish (**L**) from (**M**). Include in your answer, the reagent you would use, what would be observed and a chemical equation that explains what is occurring in the reaction.

Tollens reagent, $[Ag(NH_3)_2]^+/OH^-$.

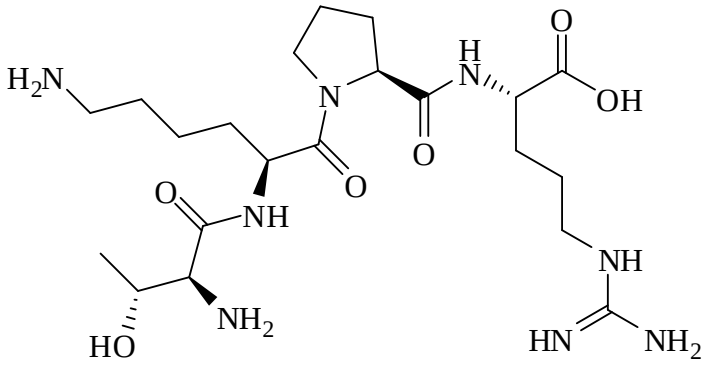
This will give no reaction with (L), but will oxidise (M). In the process, the $[Ag(NH_3)_2]^+$ ion is reduced to metallic Ag which deposits as a silver mirror.



Give the reagents to convert (**L**) to a mixture of (**M**) and the α-anomer of (**M**).	**H^+/H_2O/heat**
Give the reagents to convert (**M**) to (**L**).	**excess CH_3OH / H^+ catalyst**
Give the structure of the isomer of (**L**) also produced in the preceding reaction.	
Sugar (**M**) exists in equilibrium with an open chain form. Give the Fischer projection of this open chain form.	
List the functional groups present in (**L**).	**primary and secondary alcohol, acetal**

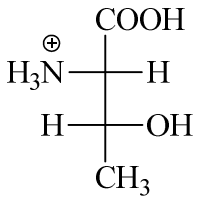
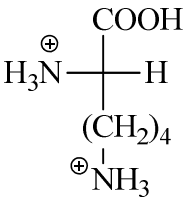
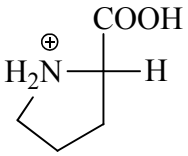
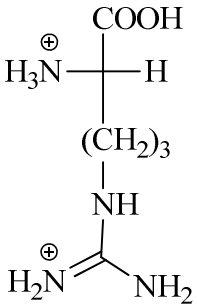
Marks 6

- Tuftsin is a tetrapeptide (Thr-Lys-Pro-Arg) produced by enzymatic cleavage of the Fc-domain of the heavy chain of immunoglobulin G. It is mainly produced in the spleen and its activity is related primarily to immune system function.



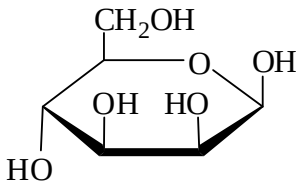
tuftsin

Draw the Fischer projections of the four L-amino acids that result from the acid hydrolysis of tuftsin.

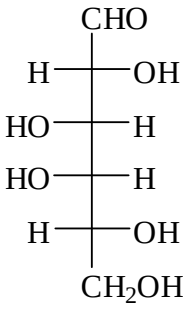
	
	

Marks 8

- Shown below are the Haworth structure of β-D-mannopyranose and the Fischer projection of D-galactose.



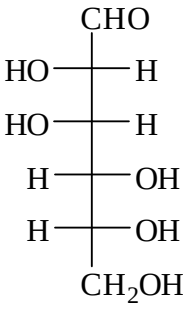
β-D-mannopyranose



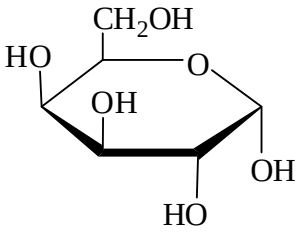
D-galactose

Draw structures for the following sugars.

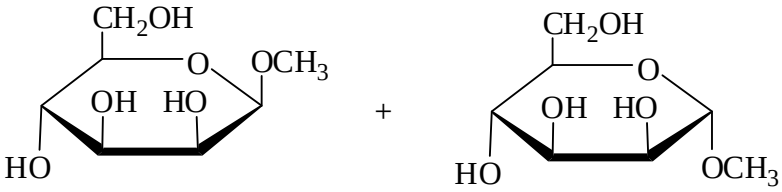
Fischer projection of D-mannose



Haworth structure of α-D-galactopyranose



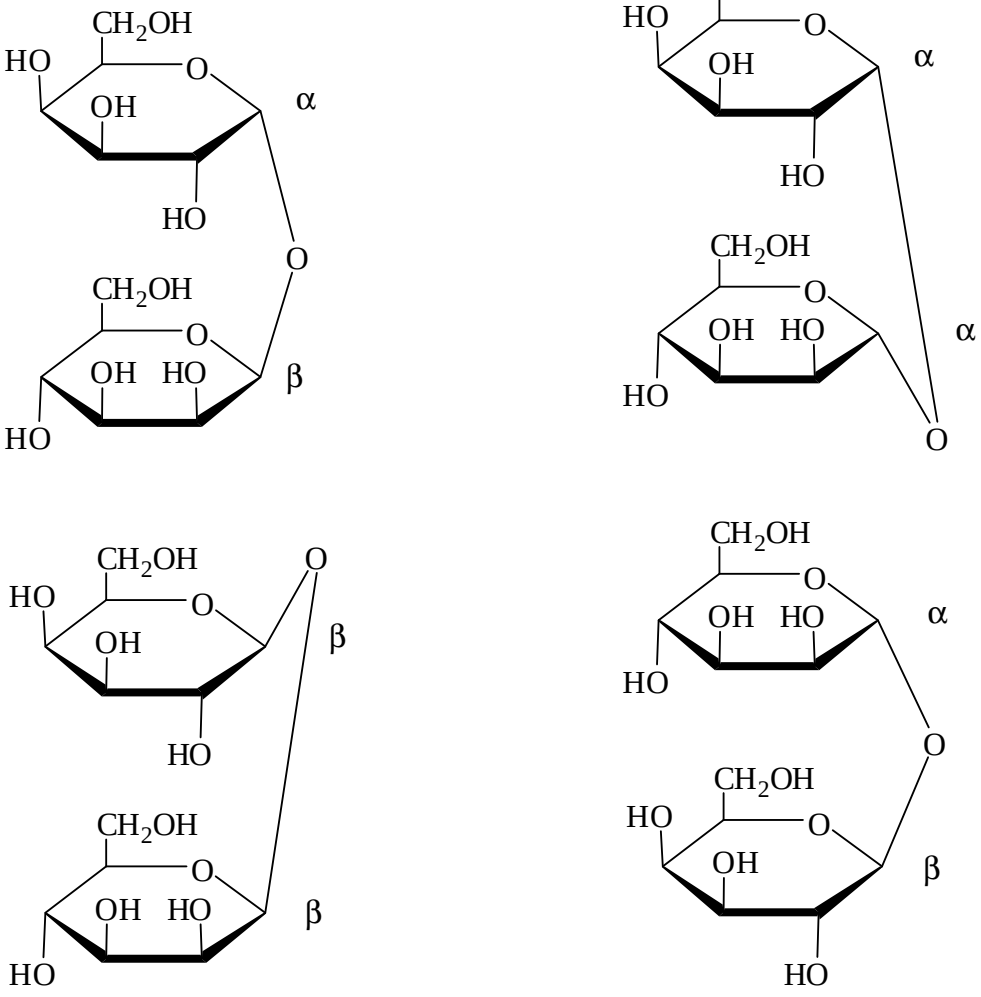
Give the product(s) obtained when D-mannose is treated with acidified methanol.



ANSWER CONTINUES ON THE NEXT PAGE

Draw the structure of any non-reducing disaccharide formed from D-mannose and D-galactose, indicating the configurations at the anomeric carbon atoms.

Any one of the following 4 structures.

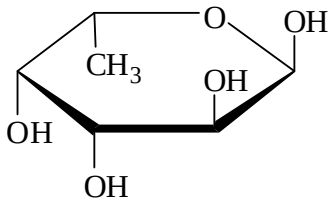
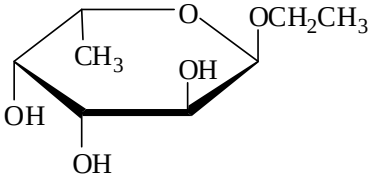
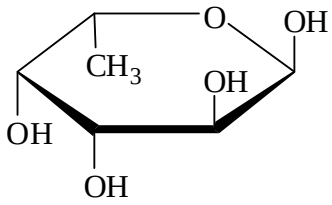
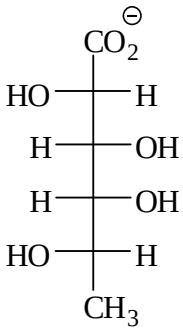


How many different non-reducing disaccharides can be formed from D-mannose and D-galactose? What is the relationship between any two of these compounds?

4 diastereomers

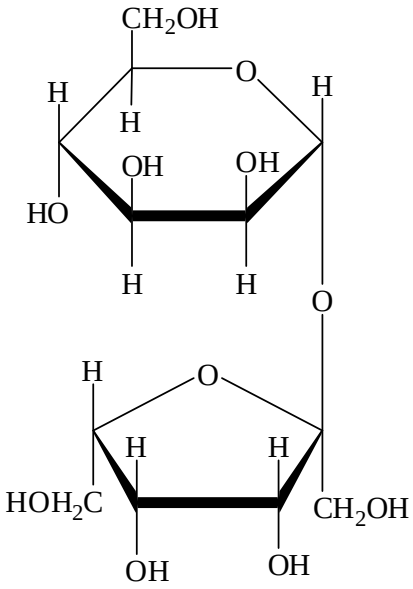
Marks 4

- Complete the following table.

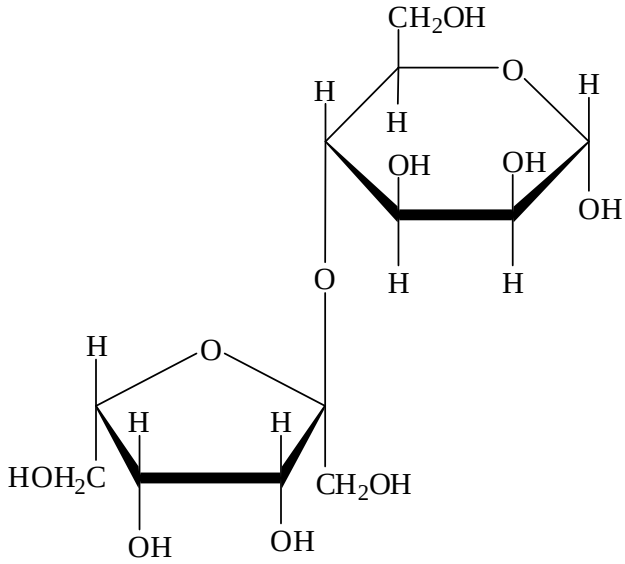
STARTING MATERIAL	REAGENTS/ CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	**CH_3CH_2OH / catalytic H^+**	
	$[Ag(NH_3)_2]^{\oplus}$ / $OH^{\ominus}$	

Marks 6

- Consider the following two disaccharides **A** and **B**.



A

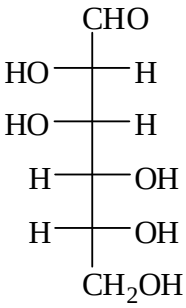
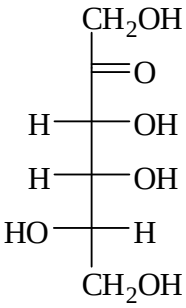


B

Classify each disaccharide as "reducing" or "not reducing".

A: **not reducing (no hemiacetal)**	**B**: **reducing (hemiacetal present)**

Both these disaccharides hydrolyse to give tagatose and mannose. Mannose is an aldohexose. Draw the Fischer projections of the open chain forms of mannose and tagatose.

Fischer projection of mannose	Fischer projection of tagatose
	

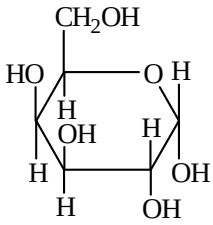
Mannose is classified as an aldohexose. What classification is given to tagatose?

ketohexose

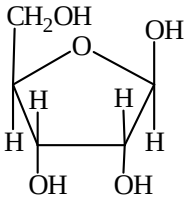
Specify the above mannose as D-mannose or L-mannose.	**D-mannose**
Specify the above tagatose as D-tagatose or L-tagatose.	**L-tagatose**

Marks 7

- Consider the following two monosaccharides **A** and **B**.



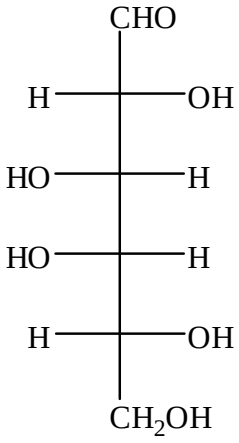
A: α-D-galactopyranose



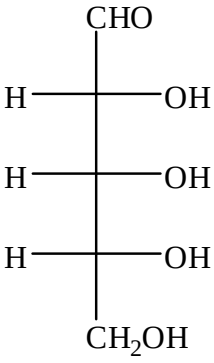
B: β-D-ribofuranose

Give the Fischer projections of the open chain form of **A** and **B**.

Fischer projection of D-galactose

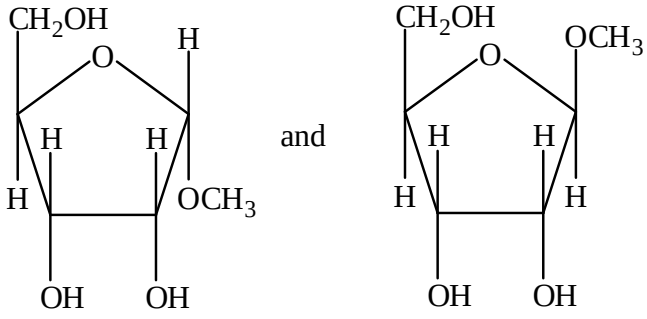


Fischer projection of D-ribose

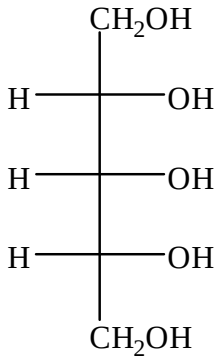


Give the products obtained when D-ribose is treated with the following reagents.

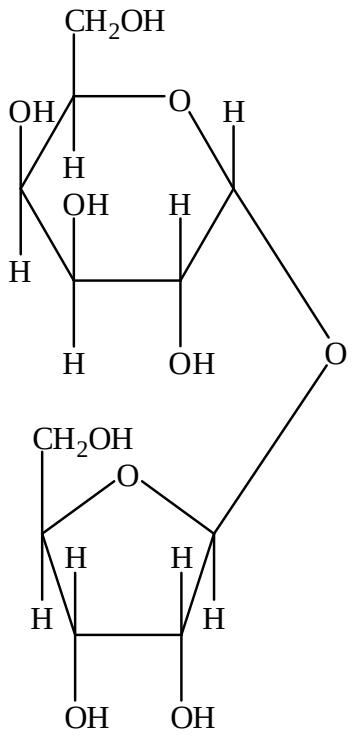
Acidified methanol



$NaBH_4$ in methanol solvent

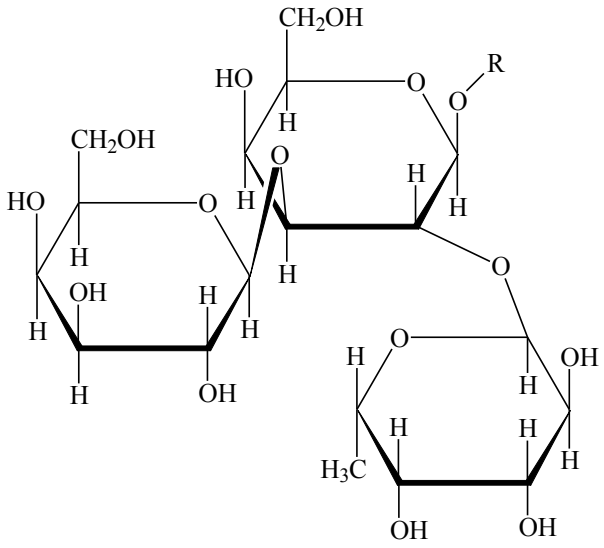


Draw the Haworth structure of a non-reducing disaccharide, which yields D-galactose and D-ribose on acid hydrolysis.



Marks 6

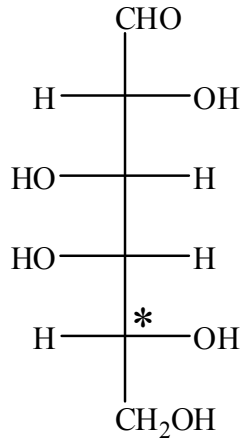
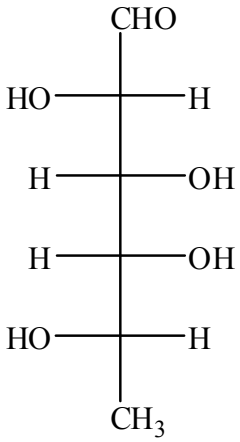
- An important group of oligosaccharides is the blood group antigens. The blood group antigen of humans with blood group B can be represented by the partial structure below, in which R is a glycoprotein.



The type B blood group antigen can be hydrolysed to galactose (2 mole equiv.), fucose (1 mole equiv.) and a glycoprotein unit.

Specify the fucose unit in the type B blood group antigen as a furanose or a pyranose.	**pyranose**
Specify fucose as a hexose, a pentose or a tetrose.	**hexose**

Give the Fischer projections of the open chain form of galactose and fucose.

Fischer projection of galactose	Fischer projection of fucose
	

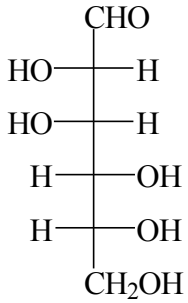
On your Fischer projection of galactose indicate with an asterisk (*) the carbon atom used in the D/L convention.

Specify the galactose from blood antigen as D-galactose or L-galactose.	**D-galactose**
Specify the fucose from blood antigen as D-fucose or L-fucose.	**L-fucose**

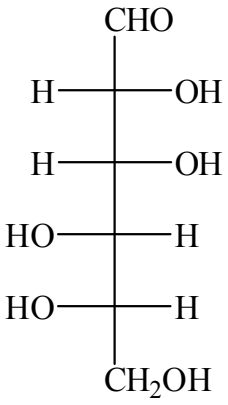
Marks 10

- The stucture of D-mannose is shown below. Draw the Fischer projection of L-mannose in the space provided.

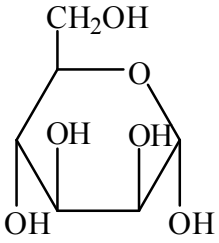
D-mannose



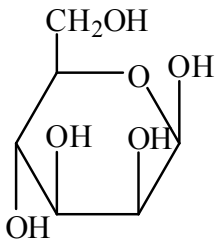
L-mannose



D-Mannose is in equilibrium with two cyclic pyranose forms. Give the Haworth projection of these two cyclic forms.



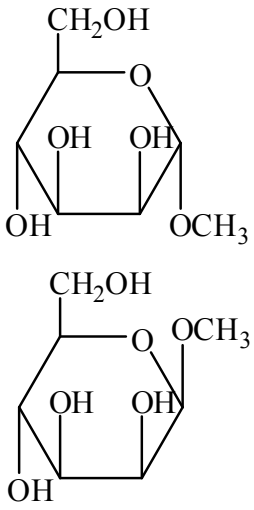
α-anomer



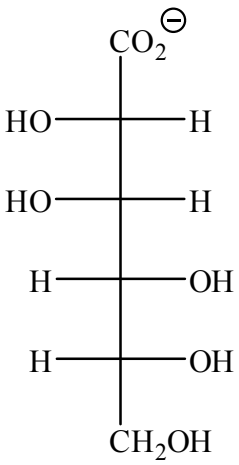
β-anomer

Give the products obtained when D-mannose is treated with the following reagents.

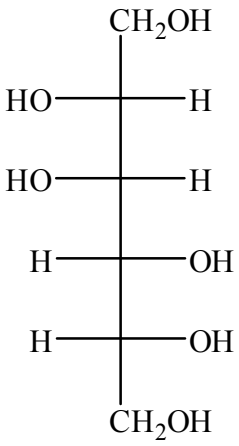
methanol / $H^{\oplus}$



$[Ag(NH_3)_2]^{\oplus}/OH^{\ominus}$ solution

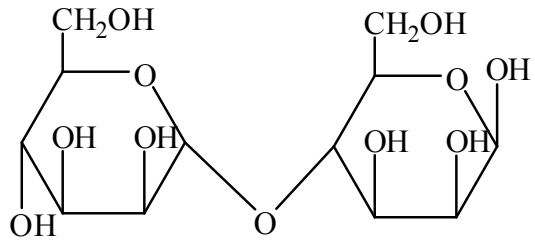


1. $NaBH_4$ 2. dilute acid



ANSWER CONTINUES ON THE NEXT PAGE

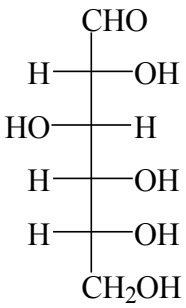
Draw the Haworth structure of a reducing disaccharide, which, on acid hydrolysis, yields D-mannose as the only product.



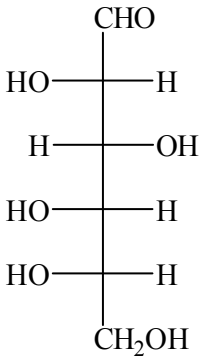
Marks 9

- The stucture of D-glucose is shown below. Draw the Fischer projection of L-glucose in the space provided.

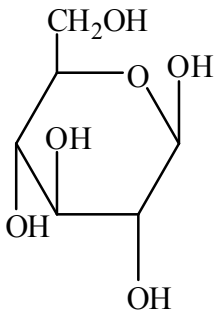
D-glucose

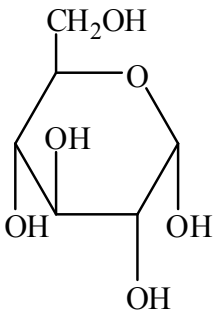


L-glucose



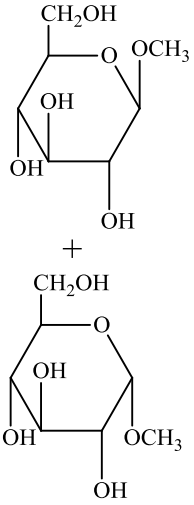
D-glucose is in equilibrium with two cyclic pyranose forms. Give the Haworth projection of these two cyclic forms.



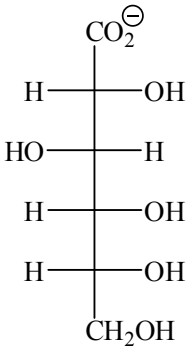


Give the products obtained when D-glucose is treated with the following reagents.

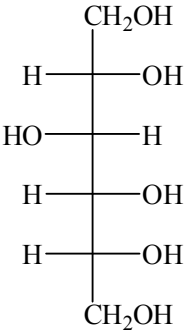
methanol / H^+



$[Ag(NH_3)_2]^+$ / OH^- solution



1. $NaBH_4$ 2. dilute acid



ANSWER CONTINUES ON THE NEXT PAGE

Draw the Haworth structure of a non-reducing disaccharide, which, on acid hydrolysis, yields D-glucose as the only product.