BIOCHEM Carbohydrates VSAQS:

1. Epimers

- Epimers are stereoisomers that differ in configuration at only one specific carbon atom.
- Glucose and galactose are C-4 epimers; glucose and mannose are C-2 epimers.
- They have the same molecular formula and belong to the same sugar series (aldose or ketose).

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2. Enantiomers

- Enantiomers are mirror-image isomers that are non-superimposable.
- They rotate plane-polarized light in opposite directions (D- and L-forms).
- Example: D-glucose and L-glucose.

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3. Anomers

- Anomers differ in configuration at the anomeric carbon (carbon 1 in aldoses, carbon 2 in ketoses).
- α-anomer: –OH on anomeric carbon is opposite to CH_2OH group; β-anomer: same side.
- Example: α-D-glucose and β-D-glucose.

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4. Optical Isomerism

- Molecules with chiral centers exhibit optical isomerism.
- They rotate polarized light: dextrorotatory (+) or levorotatory (–).
- Occurs in sugars and amino acids.

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5. Glycosides

- Glycosides are formed when a sugar binds to another molecule via a glycosidic bond.
- The anomeric –OH group is replaced by –OR or –NR group.
- They are stable and do not reduce Benedict's reagent.

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6. Benedict’s Test

- A chemical test to detect reducing sugars.
- Positive test gives a brick-red precipitate due to cuprous oxide.
- Glucose, fructose, lactose are positive; sucrose is negative.

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7. Bond in Maltose, Sucrose & Lactose

- Maltose: α-1,4-glycosidic bond (glucose + glucose).
- Sucrose: α1→β2-glycosidic bond (glucose + fructose).
- Lactose: β-1,4-glycosidic bond (galactose + glucose).

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8. PDH Complex

- Pyruvate Dehydrogenase converts pyruvate to acetyl-CoA.
- Requires 5 cofactors: TPP, lipoic acid, CoA, FAD, NAD^+.
- Links glycolysis and TCA cycle; inhibited by acetyl-CoA and NADH.

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9. Lactose Intolerance

- Caused by lactase enzyme deficiency.
- Leads to bloating, diarrhea, and gas after consuming milk.
- Undigested lactose is fermented by colonic bacteria.

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10. Alpha-Ketoglutarate Complex

- Converts α-ketoglutarate to succinyl-CoA in TCA cycle.
- Requires same 5 cofactors as PDH: TPP, CoA, NAD^+, FAD, lipoic acid.
- Generates NADH and releases CO_2.

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11. Vitamins in TCA Cycle

- Vitamin B1 (Thiamine) – coenzyme TPP in PDH & α-KG complex.
- Vitamin B2 (Riboflavin) – forms FAD.
- Vitamin B3 (Niacin) – forms NAD^+; B5 (Pantothenic acid) – part of CoA.

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12. Cahill's Cycle & Cori's Cycle

- Cahill's: Alanine cycle – transfers nitrogen to liver.
- Cori's: Lactate from muscles converted to glucose in liver.
- Both support gluconeogenesis during fasting/exercise.

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13. UDP Glucuronate Cycle

- Produces UDP-glucuronic acid from glucose.
- Important for detoxification (bilirubin, drugs) via glucuronidation.
- Defect causes Crigler-Najjar or Gilbert's syndrome.

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14. Polyol Pathway

- Converts glucose to sorbitol (aldose reductase), then to fructose.
- Active in lens, retina, nerves; excess sorbitol causes osmotic damage.
- Linked to diabetic complications.

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15. Essential Pentosuria

- Benign condition due to deficiency of L-xylulose reductase.
- Causes excretion of L-xylulose in urine.
- Common in Ashkenazi Jews; does not cause hyperglycemia.

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16. Galactosemia

- Genetic disorder due to GALT deficiency (classical type).
- Causes hepatomegaly, jaundice, cataracts, mental retardation.
- Managed by excluding galactose/lactose from diet.

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17. Galactokinase vs Hexokinase

Feature	Galactokinase	Hexokinase

Substrate	Galactose	Glucose
Product	Galactose-1-phosphate	Glucose-6-phosphate
Km	Low (high affinity)	Low (high affinity)

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18. G6PD Deficiency

- X-linked enzyme deficiency in pentose phosphate pathway.
- Leads to hemolytic anemia after oxidative stress (e.g., fava beans, drugs).
- Protects against malaria.

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19. Fructosuria & Fructosemia

- Fructosuria: Benign; deficiency of fructokinase.
- Hereditary Fructose Intolerance (fructosemia): Aldolase B deficiency; causes hypoglycemia, vomiting.
- Managed by avoiding fructose.

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20. HbA1c & Its Importance

- Glycated hemoglobin indicates average blood glucose over 2–3 months.
- Normal <5.7%; diabetic >6.5%.
- Useful for monitoring long-term glucose control.

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21. Sucrose Intolerance

- Caused by sucrase-isomaltase deficiency.
- Leads to diarrhea, gas, and abdominal discomfort after sucrose intake.
- Managed by avoiding sucrose.

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22. Invert Sugar

- Mixture of glucose and fructose from hydrolyzed sucrose.
- Sweeter than sucrose; used in candies, jams.
- Prepared using acid or invertase enzyme.

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23. Glucokinase vs Hexokinase

Feature	Glucokinase	Hexokinase
Location	Liver, pancreas	All tissues
Km	High (low affinity)	Low (high affinity)
Regulation	Induced by insulin	Inhibited by G6P

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24. Cori Cycle

- Transfers lactate from muscle to liver.
- Liver converts lactate to glucose via gluconeogenesis.
- Helps maintain blood glucose and reduces muscle fatigue.

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25. GLUT2 vs GLUT4

Feature	GLUT2	GLUT4

Location	Liver, β-cells, intestine	Muscle & adipose tissue
Insulin	Independent	Insulin-dependent
Km value	High Km (low affinity)	Low Km (high affinity)