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## Glucose Transport & Phosphorylation

Exam — Metabolism

Pre-med style questions on glucose entry into cells, GLUT transporters, SGLTs, facilitated diffusion, and phosphorylation by hexokinase and glucokinase.

30 items — Printable Exam

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**1** Which statement best describes HOW GLUT transporters move glucose across the plasma membrane?



- A** Primary active transport directly using ATP
- B** Secondary active transport using a  $\text{Na}^+$  gradient
- C** Facilitated diffusion down a concentration gradient
- D** Endocytosis of glucose-containing vesicles
- E** Simple diffusion through the lipid bilayer

**2** Which statement correctly compares GLUT transporters with SGLT transporters?



- A** Both are  $\text{Na}^+$ -dependent cotransporters
- B** GLUT uses facilitated diffusion; SGLT uses  $\text{Na}^+$ -coupled secondary active transport
- C** GLUT requires ATP; SGLT does not
- D** SGLT is only found in red blood cells
- E** GLUT moves glucose against its gradient; SGLT moves it down its gradient

**3** Why does phosphorylation of glucose to glucose-6-phosphate (G6P) help maintain glucose uptake into cells?



- A** It increases the number of GLUT transporters
- B** It converts glucose into a lipid
- C** It prevents glucose from leaving the cell and keeps intracellular free glucose low
- D** It directly opens voltage-gated  $\text{Na}^+$  channels
- E** It raises intracellular glucose concentration, reversing the gradient





4 Hexokinase and glucokinase both phosphorylate glucose to G6P. Which statement correctly contrasts their affinities ( $K_m$ ) for glucose?



- A Hexokinase has a higher  $K_m$  (lower affinity) than glucokinase
- B Both have identical  $K_m$  values
- C Hexokinase has a lower  $K_m$  (higher affinity); glucokinase has a higher  $K_m$  (lower affinity)
- D Hexokinase does not bind glucose at all
- E Glucokinase has zero affinity for glucose

5 Which tissues primarily express GLUCOKINASE (hexokinase IV)?



- A Skeletal muscle and adipose tissue
- B Liver and pancreatic  $\beta$ -cells
- C Red blood cells only
- D All tissues at equal levels
- E Brain neurons only

6 Hexokinase, but not glucokinase, is strongly inhibited by its product G6P. What is the functional consequence of this difference?



- A Peripheral tissues can keep phosphorylating glucose indefinitely
- B Liver cells stop glycolysis at low glucose concentrations
- C Peripheral tissues self-limit glucose phosphorylation when G6P accumulates, while the liver can continue storing excess glucose as glycogen
- D Glucokinase cannot phosphorylate glucose at all





**E** Hexokinase does not function in low-energy states

**7** Which GLUT isoform is **INSULIN-DEPENDENT** and found mainly in skeletal muscle, cardiac muscle and adipose tissue?



- A** GLUT1
- B** GLUT2
- C** GLUT3
- D** GLUT4
- E** GLUT5

**8** Which GLUT isoform is a **HIGH AFFINITY** transporter that supplies glucose to neurons and is largely insulin-independent?



- A** GLUT1
- B** GLUT2
- C** GLUT3
- D** GLUT4
- E** GLUT5

**9** Which GLUT isoform is mainly responsible for **BASAL** glucose uptake in many tissues and is highly expressed in red blood cells and the blood–brain barrier?



- A** GLUT1





- B GLUT2
- C GLUT3
- D GLUT4
- E GLUT5

**10** GLUT2 has a relatively HIGH  $K_m$  (low affinity) for glucose. What is a major physiological consequence of this property?



- A It is saturated at very low blood glucose levels
- B It transports glucose at a constant rate regardless of glucose concentration
- C It acts as a glucose sensor in liver and pancreatic  $\beta$ -cells, increasing transport only when glucose is high
- D It prevents any glucose uptake in the liver
- E It requires insulin to function

**11** Which GLUT isoform primarily transports FRUCTOSE, especially in the small intestine?



- A GLUT1
- B GLUT2
- C GLUT3
- D GLUT4
- E GLUT5





12 Which statement about GLUT transporters is TRUE?



- A They are ion channels that allow uncontrolled glucose flux
- B They are carrier proteins that show saturation at high glucose concentrations
- C They require ATP binding and hydrolysis at the transporter
- D They move glucose only in one direction
- E They transport glucose against its concentration gradient

13 In a hepatocyte, what is the CORRECT order of events for handling glucose shortly AFTER a carbohydrate-rich meal?



- A SGLT1 uptake → hexokinase phosphorylation → export via GLUT4
- B GLUT2 uptake → phosphorylation by glucokinase → storage as glycogen
- C GLUT1 uptake → phosphorylation by hexokinase → conversion to ketone bodies
- D GLUT4 uptake → immediate release back to blood
- E Endocytosis of intact glycogen → breakdown to glucose

14 Which statement best explains why liver can BOTH take up AND release glucose efficiently?



- A Liver lacks glucose transporters and therefore traps glucose
- B Liver expresses GLUT2 plus enzymes that can both phosphorylate and dephosphorylate glucose
- C Liver uses only SGLT and never releases glucose
- D Liver has only hexokinase, which cannot be reversed
- E Liver cells are impermeable to glucose





**15** Which of the following is TRUE regarding hexokinase in most peripheral tissues (e.g. muscle, brain)?



- A** It has LOW affinity for glucose and functions only when glucose is very high
- B** It has HIGH affinity for glucose and allows tissues to phosphorylate glucose even at low concentrations
- C** It is present only in liver
- D** It cannot use ATP
- E** It is inactive in the presence of insulin

**16** In INSULIN DEFICIENCY (untreated type 1 diabetes), which glucose transporter's activity in peripheral tissues is most directly reduced?



- A** GLUT1 in red blood cells
- B** GLUT2 in liver
- C** GLUT3 in neurons
- D** GLUT4 in skeletal muscle and adipose tissue
- E** GLUT5 in intestine

**17** Which transport process is MOST directly impaired by a drug that inhibits the  $\text{Na}^+/\text{K}^+$  ATPase in intestinal epithelial cells?



- A** GLUT2-mediated glucose efflux into blood
- B** GLUT4-mediated glucose uptake into muscle
- C** SGLT1-mediated glucose uptake from the intestinal lumen





- D Simple diffusion of CO<sub>2</sub>
- E GLUT1-mediated uptake in red blood cells

**18** Which transporter reabsorbs **MOST** of the filtered glucose in the early proximal convoluted tubule of the kidney?



- A GLUT4
- B SGLT2
- C SGLT1
- D GLUT5
- E GLUT3

**19** A new drug blocks SGLT2 in the kidney. Which effect on glucose handling is expected?



- A Increased renal reabsorption of glucose, lowering urine glucose
- B Decreased renal reabsorption of glucose, increasing urinary glucose loss
- C No change in urinary glucose
- D Complete block of intestinal glucose absorption
- E Inhibition of GLUT4 in muscle

**20** Which statement about the **FIRST** step of glycolysis (glucose → G6P) is **CORRECT**?





- A It is catalysed only by glucokinase in all tissues
- B It traps glucose inside the cell and commits it to metabolic pathways
- C It converts glucose into a lipid
- D It does not require ATP
- E It produces glucose that can easily leave via GLUT

**21** In most cells, what would be the effect of acutely inhibiting hexokinase activity while GLUT function remains normal?



- A Glucose uptake would stop because GLUT needs hexokinase
- B Glucose would accumulate inside the cell as free glucose and more easily diffuse back out
- C More G6P would be formed
- D The Na<sup>+</sup> gradient would collapse
- E GLUT would start active transport

**22** Which of the following correctly describes FACILITATED DIFFUSION of glucose via GLUT?



- A Saturable, specific, and energy-independent transport down a concentration gradient
- B Non-specific, non-saturable, energy-independent
- C Requires ATP at the transporter site for each glucose
- D Moves glucose against its concentration gradient
- E Continuous regardless of concentration differences





**23** Which of the following **BEST** explains why the brain's glucose uptake is relatively unaffected in early insulin deficiency?

- A** Brain uses only GLUT4, which is insulin-independent
- B** Brain uses mainly GLUT3 and GLUT1, which are insulin-independent, high-affinity transporters
- C** Brain does not require glucose
- D** Insulin cannot cross the blood–brain barrier
- E** Brain has large glycogen stores to replace glucose



**24** Which GLUT isoform is mainly responsible for glucose exit from hepatocytes into the blood during fasting?

- A** GLUT1
- B** GLUT2
- C** GLUT3
- D** GLUT4
- E** SGLT1



**25** Which statement correctly links **INSULIN**, **GLUT4** and **HEXOKINASE** in skeletal muscle after a meal?

- A** Insulin decreases GLUT4 and hexokinase activity, limiting glucose uptake
- B** Insulin increases GLUT4 translocation and hexokinase activity, enhancing glucose uptake and phosphorylation
- C** Insulin acts only on hexokinase and not on GLUT4
- D** Insulin blocks glucose phosphorylation, preventing glycolysis
- E** Insulin causes glucose to leave muscle cells via GLUT4





**26** Which of the following is **MOST** responsible for the fact that glucose can reach a transport **MAXIMUM** ( $T_m$ ) in renal tubules at high plasma glucose levels?



- A** Non-saturable simple diffusion
- B** Limited number of SGLT transporters that can become saturated
- C** Unlimited capacity of SGLT transporters
- D** Insulin-dependent GLUT4 in the kidney
- E** Direct ATP binding to GLUT1

**27** Which of the following would **MOST DIRECTLY REDUCE** the gradient driving **GLUT-mediated glucose entry into a cell**?



- A** Increased hexokinase activity
- B** Decreased hexokinase activity so intracellular free glucose rises
- C** Increased expression of GLUT
- D** Decreased blood glucose concentration
- E** Increased  $\text{Na}^+/\text{K}^+$  pump activity

**28** Which of the following pairs is **CORRECTLY** matched with its **MAIN substrate**?



- A** SGLT1 –  $\text{Na}^+$  and glucose cotransport
- B** GLUT5 –  $\text{Na}^+$  and fructose cotransport
- C** GLUT4 – ATP-driven glucose pump
- D** Hexokinase – phosphorylation of fructose only





- E** Glucokinase – phosphorylation of amino acids only

**29** Which of the following best describes the **ROLE** of glucokinase in pancreatic  $\beta$ -cells?



- A** It blocks insulin secretion at high glucose
- B** It serves as a glucose sensor by phosphorylating glucose in proportion to blood levels, helping regulate insulin release
- C** It is inhibited by G6P, switching off insulin at high glucose
- D** It converts glucose directly to glycogen in  $\beta$ -cells
- E** It has no role in  $\beta$ -cells, only in hepatocytes

**30** Which concise statement correctly summarises the division of labour between GLUTs and hexokinase/glucokinase in cellular glucose handling?



- A** GLUTs trap glucose inside the cell; kinases move it across membranes
- B** GLUTs move glucose across membranes; hexokinase/glucokinase trap it by phosphorylation
- C** Both GLUTs and kinases are required for glucose to leave the cell
- D** Kinases transport glucose, GLUTs phosphorylate it
- E** Neither GLUTs nor kinases are involved in glucose uptake





#	Ans	Answer Text
	C	
2	B	GLUT uses facilitated diffusion; SGLT uses Na <sup>+</sup> -coupled secondary active ...
	C	
4	C	Hexokinase has a lower Km (higher affinity); glucokinase has a higher Km...
	B	
6	C	Peripheral tissues self-limit glucose phosphorylation when G6P accumulat...
	D	
8	C	GLUT3
	A	
10	C	It acts as a glucose sensor in liver and pancreatic $\beta$ -cells, increasing ...
	E	
12	B	They are carrier proteins that show saturation at high glucose concentra...
	B	
14	B	Liver expresses GLUT2 plus enzymes that can both phosphorylate and depho...
	B	
16	D	GLUT4 in skeletal muscle and adipose tissue
	C	
18	B	SGLT2
	B	
20	B	It traps glucose inside the cell and commits it to metabolic pathways
	B	
22	A	Saturable, specific, and energy-independent transport down a concentrati...
	B	
24	B	GLUT2
	B	
26	B	Limited number of SGLT transporters that can become saturated
	B	
28	A	SGLT1 – Na <sup>+</sup> and glucose cotransport
	B	
30	B	GLUTs move glucose across membranes; hexokinase/glucokinase trap it by p...

