

BI/CH 422 & BI/CH 622

One-Hour Examination # 1

Wednesday, February 8, 2012

Name..... I.D.#.....

Please circle the course you are taking: BI 422; CH 422; BI 622; CH 622.

Answer each question briefly and concisely, preferably illustrated by a diagram.

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1. How would you determine whether a water-soluble substance S crosses the cell membrane by **simple** or **facilitated** diffusion? (2 marks)

Ans:

A plot of V (rate of entry) versus $[S]$ would be linear for **simple** diffusion but would exhibit Michaelis-Menten kinetics for **facilitated** diffusion.

2. By what transport mechanisms is glucose taken up from the gut and released into the blood stream? (3 marks)

Ans:

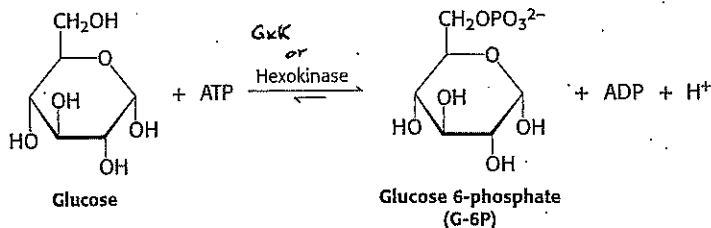
- (i) Glucose is taken up via symport with Na^+
- (ii) Glucose passes into the blood stream via facilitated diffusion
- (iii) Na^+ exchanges with K^+ via an $(\text{Na}^+ / \text{K}^+) \text{-ATPase}$.

3. In you and me, Hexokinase (HxK) and glucokinase (GxK) catalyse chemically identical reactions.

- (a) What is this reaction? [Use structural formula for the substrate]
 - (b) How do these enzymic processes differ? (4 marks)

Ans:

(a)



- (b) HxK is primarily active in muscle; GxK in the liver

HxK exhibits Michaelis-Menten kinetics with K_m of $<0.1\text{mM}$; GxK gives sigmoid kinetics with K_m of approx. 5mM ;

HxK is "feedback" inhibited by glucose 6P; GxK is not.

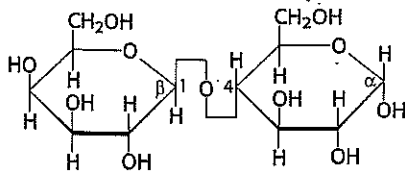
4. Yeast extract will catalyse the formation of ethanol and CO_2 from glucose if inorganic phosphate is also added. What accumulates if phosphate is not added? And why? (3 marks)

Ans:

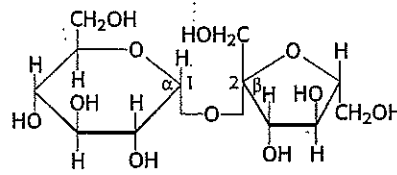
Fructose 1,6-bis phosphate accumulates (1 mark) ; if glyceraldehydes 3-phosphate is not removed via glyceraldehyde 3-phosphate dehydrogenase (GAPDH) , the equilibrium of aldolase would favor the formation, rather than the cleavage, of fructose 1,6-bisphosphate (2 marks).

5. Identify the following disaccharides:

(a)



(b)



Ans:

(a) Lactose; (b) Sucrose;

6. How is fructose converted to intermediates of glycolysis in (a) liver and (b) muscle? (4 marks)

Ans:

(a) Fructose + ATP = Fructose 1-P + ADP (fructokinase)
Fructose 1-P = DHAP + Glyceraldehyde (F 1-P aldolase)
Glyceraldehyde + ATP = Glyceraldehyde-3-P + ADP

(b) Fructose + ATP = Fructose 6-P + ADP (hexokinase)

7. How is galactose converted to glucose 1-phosphate?

(3 marks)

Ans.:

Galactose + ATP = Galactose 1-phosphate
Galactose 1-phosphate + UDP-glucose = UDP-galactose + glucose 1-phosphate
UDP-galactose (epimerase) = UDP-glucose

8. How are Glucose 1-P and Glucose 6-P interconverted?

(2 marks)

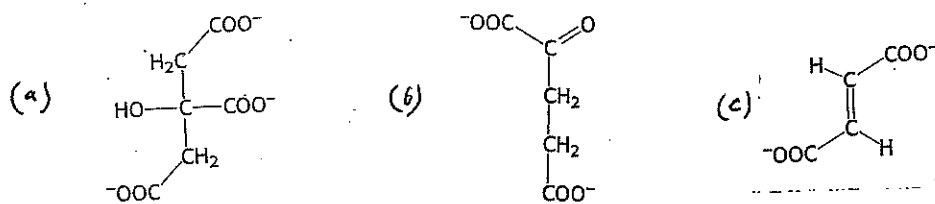
Ans.:

Glucose 1-P + Enzyme-P = Glucose 1,6-bisP + Enzyme
Glucose 1,6-bisP + Enzyme = Enzyme-P + Glucose 6-P

9. Describe, in outline, the sequence of steps whereby CO₂ , acetyl-coenzyme A, and [NADH + H⁺], are formed from pyruvate. (5 marks)

Ans: i) Pyruvate + TPP = Hydroxyethyl-TPP + CO₂
ii) Hydroxyethyl-TPP + Lip.SS = HS.Lip.S-acetyl + TPP
iii) HS.Lip.S-acetyl + CoA.SH = HS.Lip.SH + acetyl-S.CoA
iv) HS.Lip.SH + FAD = Lip.SS + FADH₂
v) FADH₂ + NAD⁺ = FAD + NADH + H⁺

10. Write down the structural formulae of (a) citrate; (b) α -ketoglutarate; (c) fumarate (3 marks)



11. In which steps of the tricarboxylic acid (TCA) cycle is NAD^+ reduced to $\text{NADH} + \text{H}^+$? (3 marks)

Ans:

Isocitrate = *α -ketoglutarate*
 α -ketoglutarate = *succinyl-CoA*
malate = *oxaloacetate*

12. Write down the mechanism of the one substrate-linked phosphorylation in the TCA cycle. (3 marks)

Ans:

Succinyl-S.CoA + Pi = *Succinyl-phosphate + CoA.SH*
Succinyl-phosphate + Enzyme-His = *Succinate + Enzyme 3-phospho-His*
Enzyme 3-phospho-His + GDP = *Enzyme-His + GTP*