

## 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:

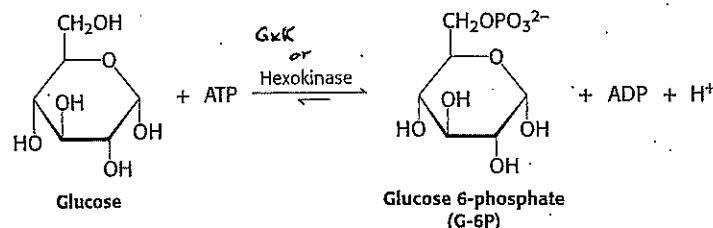
- (i) Glucose is taken up via symport with  $\text{Na}^+$
- (ii) Glucose passes into the blood stream via facilitated diffusion
- (iii)  $\text{Na}^+$  exchanges with  $\text{K}^+$  via an  $(\text{Na}^+ / \text{K}^+)$ -ATPase.

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.  $5\text{mM}$ ;

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

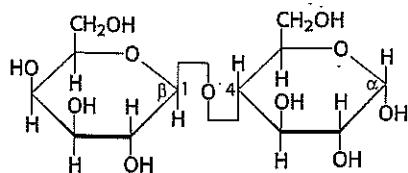
4. Yeast extract will catalyse the formation of ethanol and  $\text{CO}_2$  from glucose if inorganic phosphate is also added. What accumulates if phosphate is not added? And why? (3 marks)

Ans:

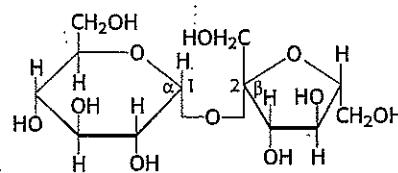
Fructose 1,6-bis phosphate accumulates (1 mark); if glyceraldehydes 3-phosphate is not removed via glyceraldehyde 3-phosphate dehydrogenase (GAPDH), the equilibrium of aldolase would favor the formation, rather than the cleavage, of fructose 1,6-bisphosphate (2 marks).

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)  $\text{Fructose} + \text{ATP} = \text{Fructose 1-P} + \text{ADP}$  (fructokinase)  
 $\text{Fructose 1-P} = \text{DHAP} + \text{Glyceraldehyde}$  (F 1-P aldolase)  
 $\text{Glyceraldehyde} + \text{ATP} = \text{Glyceraldehyde-3-P} + \text{ADP}$

(b)  $\text{Fructose} + \text{ATP} = \text{Fructose 6-P} + \text{ADP}$  (hexokinase)

7. How is galactose converted to glucose 1-phosphate? (3 marks)

Ans.:

$\text{Galactose} + \text{ATP} = \text{Galactose 1-phosphate}$   
 $\text{Galactose 1-phosphate} + \text{UDP-glucose} = \text{UDP-galactose} + \text{glucose 1-phosphate}$   
 $\text{UDP-galactose} \text{ (epimerase)} = \text{UDP-glucose}$

8. How are Glucose 1-P and Glucose 6-P interconverted? (2 marks)

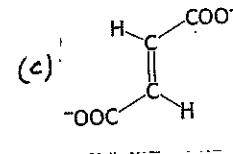
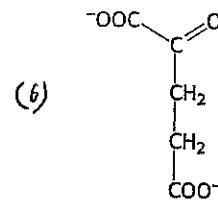
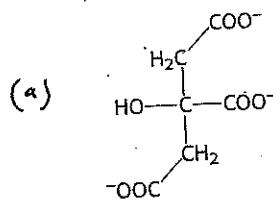
Ans.:

$\text{Glucose 1-P} + \text{Enzyme-P} = \text{Glucose 1,6-bisP} + \text{Enzyme}$   
 $\text{Glucose 1,6-bisP} + \text{Enzyme} = \text{Enzyme-P} + \text{Glucose 6-P}$

9. Describe, in outline, the sequence of steps whereby  $\text{CO}_2$ , acetyl-coenzyme A, and  $[\text{NADH} + \text{H}^+]$ , are formed from pyruvate. (5 marks)

Ans: i)  $\text{Pyruvate} + \text{TPP} = \text{Hydroxyethyl-TPP} + \text{CO}_2$   
ii)  $\text{Hydroxyethyl-TPP} + \text{Lip.SS} = \text{HS.Lip.S-acetyl} + \text{TPP}$   
iii)  $\text{HS.Lip.S-acetyl} + \text{CoA.SH} = \text{HS.Lip.SH} + \text{acetyl-S.CoA}$   
iv)  $\text{HS.Lip.SH} + \text{FAD} = \text{Lip.SS} + \text{FADH}_2$   
v)  $\text{FADH}_2 + \text{NAD}^+ = \text{FAD} + \text{NADH} + \text{H}^+$

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



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

(3 marks)

Ans:

Isocitrate =  $\alpha$ -ketoglutarate

$\alpha$ -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.SHs

Succinyl-phosphate + Enzyme-His = Succinate + Enzyme 3-phospho-His

Enzyme 3-phospho-His + GDP = Enzyme-His + GTP