BCH 4053 **HOUR TEST 3** **NAME______KEY__________**
April 4, 2003

Page	Points
1	36
2	32
3	17
4	15
Total	100

(6) 1. Give two experimental features that would distinguish between passive diffusion and facilitated diffusion in the transport of a substance across a cell membrane.

3 pts each

two of three: rate versus concentration shows saturation behavior
specificity as to substance being transported
can be inhibited by specific inhibitors

(10) 2. Classify each of the following transport systems according to the terms in the list at the right by putting the appropriate letter or letters in the blank next to the transport system. More than one term may apply.

2 pts each blank

__e, f___ glucose transporter of erythrocytes

__d, f___ anion transporter of erythrocytes

__a, d___ Na^+/K^+ ATPase of plasma membrane

__a, (e)__ Ca^{2+} ATPase of sarcoplasmic reticulum

__b, c___ amino acid uptake driven by a Na^+ gradient

a. primary active transport
b. secondary active transport
c. symport
d. antiport
e. uniport
f. facilitated diffusion

(8) 3. You have prepared DNA from two organisms isolated from the swamps of south Georgia, designated **culture A** and **culture B**. DNA from **culture A** contains 28% G, while DNA from **culture B** contains 23% G. Complete the following table for the expected composition of the other purine and pyrimidine bases.

1 pt each value, 2 pts correct higher melting culture

	%G	%A	%T	%C	Total
Culture A	28	_22_	_22_	_28_	100%
Culture B	23	_27_	_27_	_23_	100%

DNA from which organism will have the higher melting temperature? Culture A

(12) 4. Which form of DNA helix (**A**, **B**, or **Z**): (put answer in blank)

2 pts ea.

_A__ has the greatest tilt angle of the base pairs?

_Z__ has a left-handed helix?

_Z__ has deoxyguanosine in the **syn** conformation?

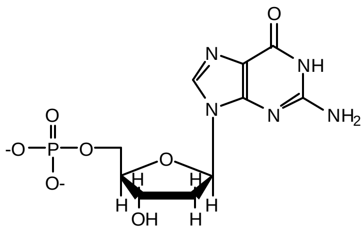
_A__ is favored by low humidity?

_Z__ is favored by high GC content?

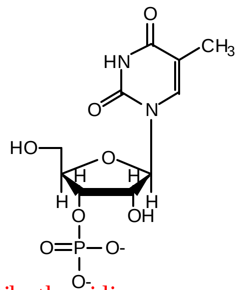
_A__ is formed by RNA-DNA hybrids?

(12) 5. Name the following structures, and indicate whether they can be found in DNA, RNA, or both.

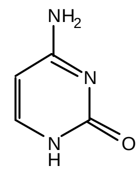
1 pt name, 1 pt location



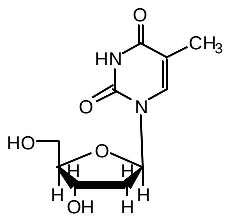
Deoxyguanosine-(5'-)monophosphate (DNA)



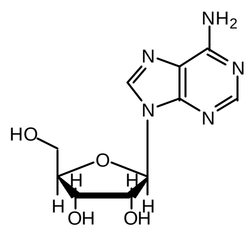
Ribothymidine-3'-monophosphate (RNA)



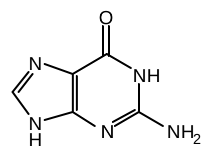
Cytosine (both)



Thymidine (DNA)



Adenosine (RNA)



Guanine (both)

(12) 6. Name the six classes of enzymes according to the International Commission on Enzymes classification scheme.

2 pts each

1. Oxidoreductases
2. Transferases
3. Hydrolases
4. Lyases
5. Isomerases
6. Ligases

(8) 7. Which of the following are assumptions made in the **original** derivation of the Michaelis-Menten equation for a one-substrate, one-product reaction? (Not the Briggs-Haldane modification. Put a check by the appropriate assumptions.)

1 pt each blank correctly marked

_X__ $[S] >> [E_{total}]$.

____ $[E_{total}] >> [E_{free}]$.

_X__ $K_M = [E][S]/[ES]$

____ The rate of formation of ES equals its rate of breakdown.

____ The velocity of the catalyzed reaction is equal to $k_1[E][S]$.

____ The rate of breakdown of ES to E + P is much faster than the rate of breakdown of ES back to E + S.

____ The concentration of ES is small relative to the concentration of E_{total}.

_X__ The rate of reaction is equal to $k_2[ES]$.

(17) 8. Following are three models for reversible inhibition of a simple one-substrate enzyme reaction:

(A)
$$E + S \rightleftarrows ES \rightarrow E + P$$
$$E + I \rightleftarrows EI$$

(B)
$$E + S \rightleftarrows ES \rightarrow E + P$$
$$ES + I \rightleftarrows ESI$$

(C)
$$E + S \rightleftarrows ES \rightarrow E + P$$
$$E + I \rightleftarrows EI$$
$$ES + I \rightleftarrows ESI$$

where

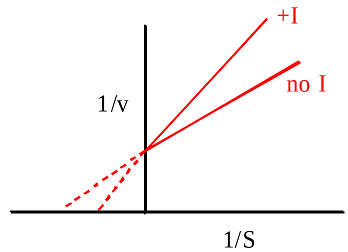
$$K_I = \frac{[E][I]}{[EI]}$$

and

$$K'_I = \frac{[ES][I]}{[ESI]}$$

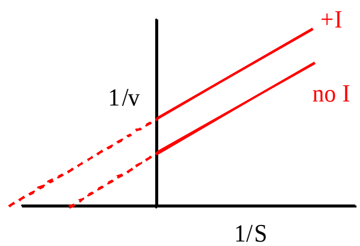
(a) For each of the above models, complete the reciprocal form of the rate equation given below, and draw two lines on each of the Lineweaver Burke plots for each rate equation, one line showing no inhibitor, one line showing the presence of inhibitor (indicate which line is which): 2 pts each figure, 2 pts each equation, deduct only 1 pt if K_I and K'_I are mixed up.

A.



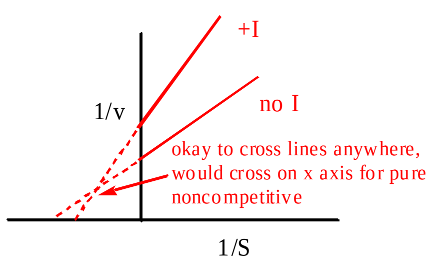
$$\frac{1}{v} = \frac{1}{V_m} + \frac{K_m}{V_m}\left(1 + \frac{I}{K_I}\right)\frac{1}{S}$$

B.



$$\frac{1}{v} = \frac{1}{V_m}\left(1 + \frac{I}{K'_I}\right) + \frac{K_m}{V_m}\frac{1}{S}$$

C.



$$\frac{1}{v} = \frac{1}{V_m}\left(1 + \frac{I}{K'_I}\right) + \frac{K_m}{V_m}\left(1 + \frac{I}{K_I}\right)\frac{1}{S}$$

(b) Which of the above models (**A, B, or C**) correspond to 1 pt each blank

competitive inhibition __A_____

pure noncompetitive inhibition __C ($K_I = K'_I$)_

uncompetitive inhibition _B_____

mixed noncompetitive inhibition _C ($K_I \neq K'_I$)_

not competitive _B and C__

(5) 9. The pH-rate profile for ribonuclease is bell shaped, with a pH maximum at 6.0 and inflection points of approximately 5.8 and 6.2 in the two sides of the curve.

(a) What amino acid side chain(s) would be likely candidates for titration at these pK values?

1 pt. (accept any of the three choices)

Histidine, or aspartate or glutamate (the latter two with shifted pK's).

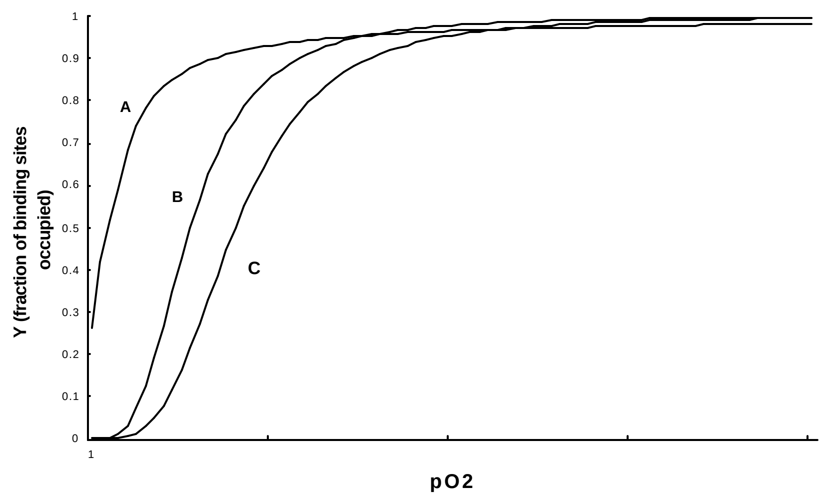
(b) Presumably the groups responsible for these pH effects would be involved in general-acid or general-base catalysis in the mechanism. Identify by pK (5.8 or 6.2) the

2 pts each

_6.2_ general-acid catalyst

_5.8_ general-base catalyst

(10) 10. The following graph shows three idealized curves that could describe oxygen binding to a transport protein such as hemoglobin or myoglobin. Identify by letter the curve or curves that represent the situations described in the comparisons below.



1 pt each blank

(a) Comparing fetal hemoglobin (_B___) to normal hemoglobin A (__C___).

(b) Comparing hemoglobin (_B or C__) to myoglobin (__A___).

(c) Comparing hemoglobin at pH 7.4 (__B___) to hemoglobin at pH 7.2 (_C__).

(d) Comparing hemoglobin (_B or C_) to hemoglobin dissociated into subunits (__A___).

(e) Comparing hemoglobin with normal bis-phosphoglycerate (BPG) (_C___) to hemoglobin with a lower concentration of bis-phosphoglycerate (BPG) (_B___)