MBB 694:407, 115:511
First Test Severinov/Deis
Tue. Sep. 30, 2003

Name KEY 1
Index number (not SSN) _____
Row Letter ____ Seat Number _____

This exam consists of two parts. Part I is multiple choice. Each of these 25 questions is worth two points. Answer the Part I questions on this sheet, below. Answer the Part II questions on the question pages.

Please use BLOCK CAPITAL letters like this --- A, B, C, D, E. Not lowercase!

1. B
2. A
3. C
4. C
5. C
6. B, E
7. D
8. ~~A~~ B
9. B
10. C
11. D
12. A
13. B
14. C
15. B
16. B
17. B
18. D
19. A
20. A
21. C
22. C
23. A
24. B
25. C (D?) ← D is answer also accept "C"

GRADE:

Part I Total _____

Part II:

II-1 _____
II-2 _____
II-3 _____
II-4 _____
II-5 _____

Part II Total _____

Total, I & II _____

 Name _____

PART II Answer these questions here on the question pages.

1. a. One mole of Alanine is dissolved in one liter of water, at its isoelectric point. 0.3 moles of NaOH is added to the solution. If the pKa of the carboxyl group is 2.4 and the pKa of the amino group is 9.4, calculate 1) the Isoelectric point, i.e. the pH before Sodium Hydroxide was added and 2) the pH after the addition. State equations, show work, and circle both answers.

(4)

$pI = \frac{2.4+9.4}{2} = \frac{11.8}{2} = 5.9$ (1 pt)

$pH = pKa + \log \frac{A}{HA}$ ← (1 pt)

$= 9.4 + \log \frac{.3}{.7}$

$= 9.4 + (-.37)$

$= 9.03$ ← (2 pts)

b. The standard free energy change for the reaction [A] --> [B] + [C] is –16 kJ/mol. If the concentrations observed are [A] = 1 M, [B] = 2 M, and [C] = 3 M, calculate 1) the equilibrium constant for this reaction and 2) the actual free energy change. State equations, show work, circle both answers. R = 8.3 ~~kJ/mol~~ J/mol °K deg, and T = 300 K.

(4)

1 pt either formula

$\Delta G^{o\prime} = -RT \ln Keq$

$Keq = e^{-\Delta G^{o\prime}/RT} = e^{+16000/8.3 \cdot 300}$ (1 pt)

2490

$e^{+6.4} = 1.6 \times 10^{-3}$ or .0016 → 602

1 pt

$\Delta G = \Delta G^{o\prime} + RT \ln \frac{P}{R}$ (1 pt)

$= (-16) + \frac{(.0083)(300)}{2.49} \ln \frac{6}{1.79} = -16 + 4.46 = -11.5 \frac{kJ}{m}$

c. In class, life was called an "emergent property of biomolecules." What does "emergent property" mean? Give a different example.

(2)

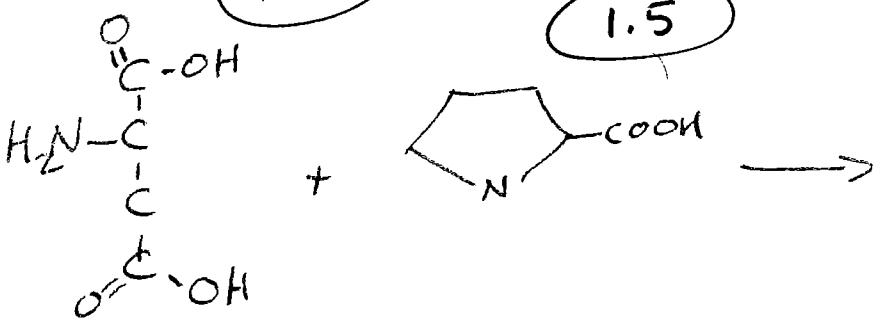
something that can't be predicted
sum = more than parts
drops of water → big wave
birds fly in spherical shape
etc,

2 points if remotely correct

 Name _____

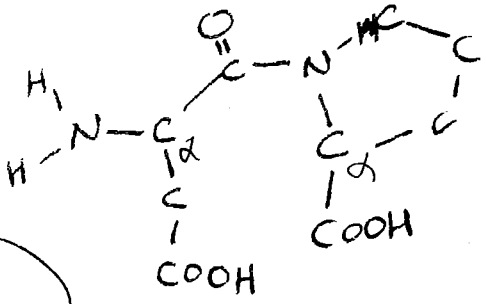
2. **7 points. a.** Using structural formulae, schematically draw the reaction of the DP dipeptide formation from D and P substrates. Draw the reaction product in a *cis* conformation.

1.5



1.5

can have
COO^-
NH_3^+
in all
structures



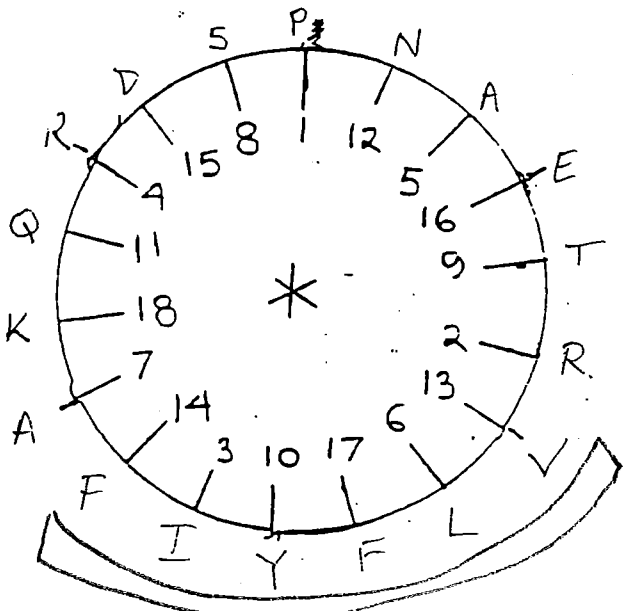
$+ H_2O$

water
1 point

3 points

↑ ↑ cis: ~~carboxyls~~ α carbons
near each other

3 points b. The "end view" of a segment of alpha helix is represented below. What can you tell about the orientation of the helix in its globular protein? Be specific.

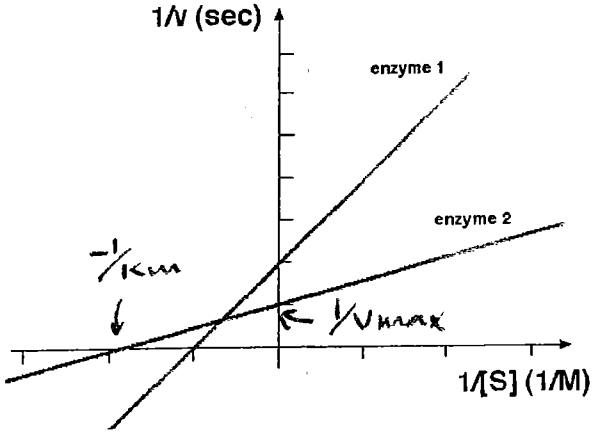


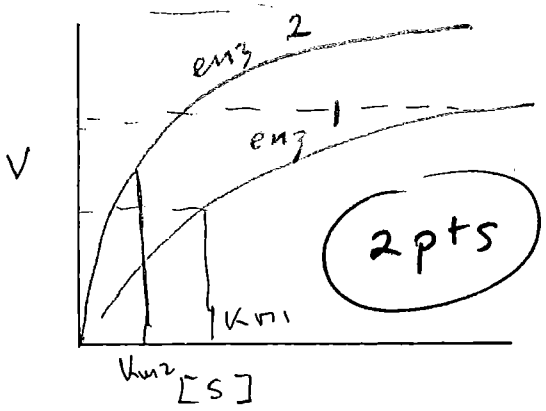
Bottom is inward
toward hydrophobic core

Rest is hydrated
∴ outward

 Name _____

3. **7 points. a.** The graph below shows the enzymatic activity of two enzymes that perform the same enzymatic reaction. Which of the two enzymes has a higher affinity for the substrate? Which of the two enzymes has higher turnover number? Replot the enzymatic activity data in direct coordinates [v([s])].





2.5 Enzyme 2 has higher Vmax ∴ K_2 turnover number is also higher

2.5 or Enzyme 2 has smaller Km ∴ higher affinity for substrate

3 points b. Given Vmax = 100, Km = 7 mM, [S] = 3 mM calculate the initial rate of the enyzme reaction. State equation and show work for full credit. Circle answer.

$V = V_{max}\left(\frac{S}{S+K_m}\right)$ ← 1 pt formula

$= 100\left(\frac{3}{3+7}\right) = 30\ mM/sec$ ← 2pts

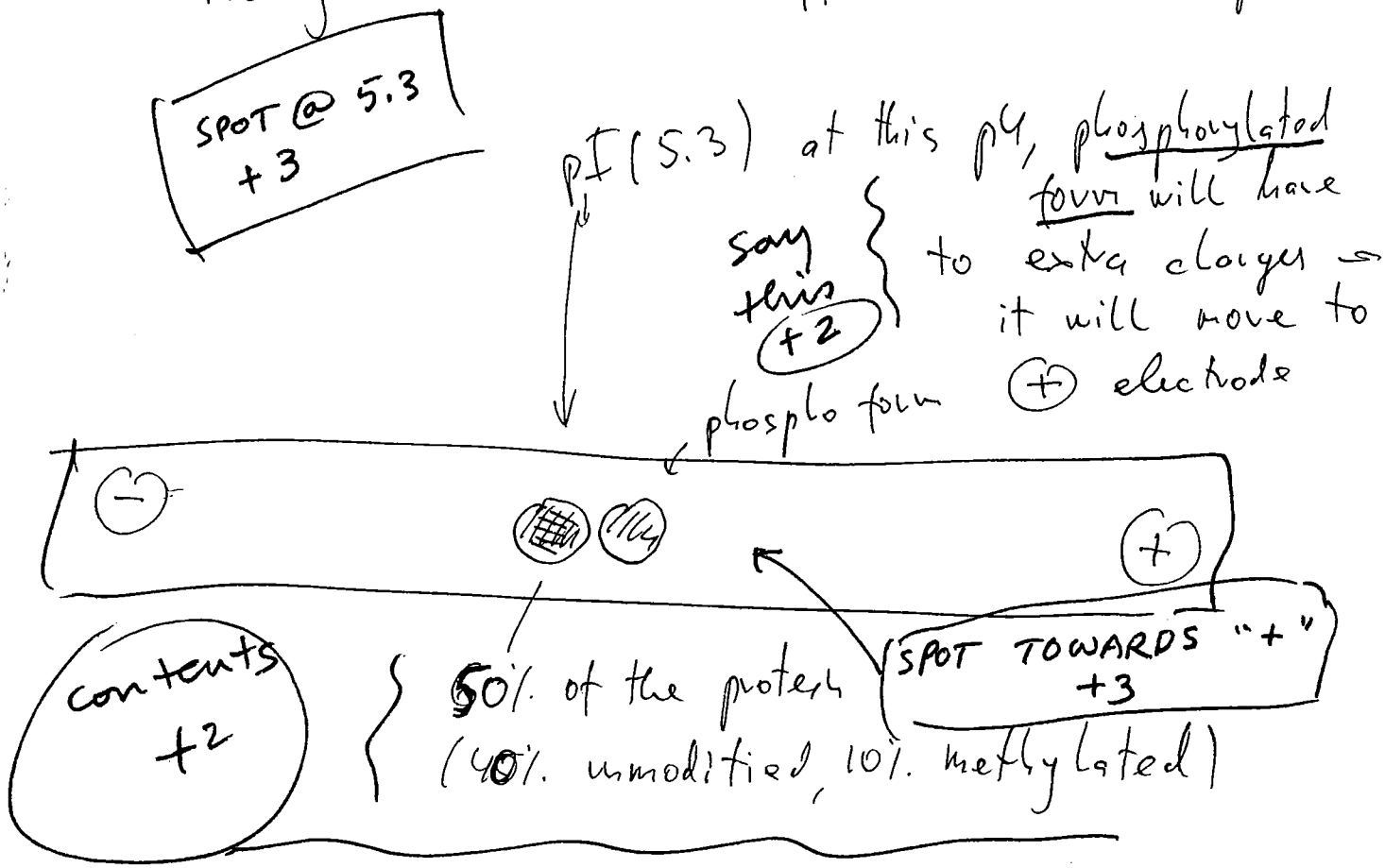
 Name _____

4. **10 points.** Protein Y has a pI value of 5.3. 50% of this protein is phosphorylated at a Serine residue. Another 20% have a Lysine residue methylated. A sample of protein Y was resolved by isoelectrofocusing and revealed by staining. Schematically draw the expected pattern; indicate which bands will contain unmodified and modified forms of the protein; indicate the polarity of the electric field used to separate the protein by labeling the electrodes as – and +.

Phosphorylation introduces 2 negative charges.

The pI of the protein becomes

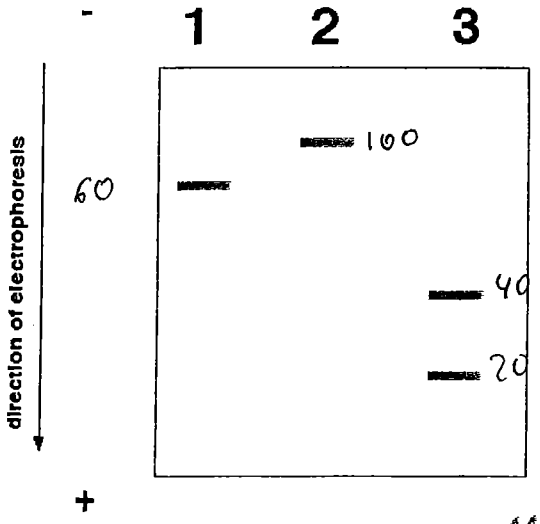
Methylation has no effect on the pI



DON'T TAKE OFF MORE THAN 1 POINT IF THEY ARE "FOOLED" BY $-N-CH_3$ AND ADD A THIRD SPOT

 Name _____

5. **10 points.** An SDS gel schematically presented below shows the results of separation of protein mixture containing four polypeptides of 100, 60, 40 and 20 kDa on a gel filtration column (numbers at the top refer to fraction numbers; a smaller number indicates that a corresponding fraction eluted earlier from the column). Identify bands on the gel and provide a plausible explanation for the result of chromatographic separation.



large

↓ via SDS PAGE

small

← NUMBERED BANDS! 2 POINTS =

big → small via gel filtration

For Lane 3:

Proteins 40 and 20 seem to form a complex ⇒ this is why they elute together.] 4 pt =

Protein of 60 kDa elutes earlier than it should. It is either an oligomer, or it has an unusual (elongated) shape

4 pt =