

Name: Answer Key

Recitation Section or TA: _____

7.013 Exam Two -- 2007

Exam starts at 11:05 am and ends at 11:55 am.

There are 10 pages including this cover page.

Please write your name on each page.

Only writing on the **FRONT** of every page will be graded.

(You may use the backs, but only as scratch paper.)

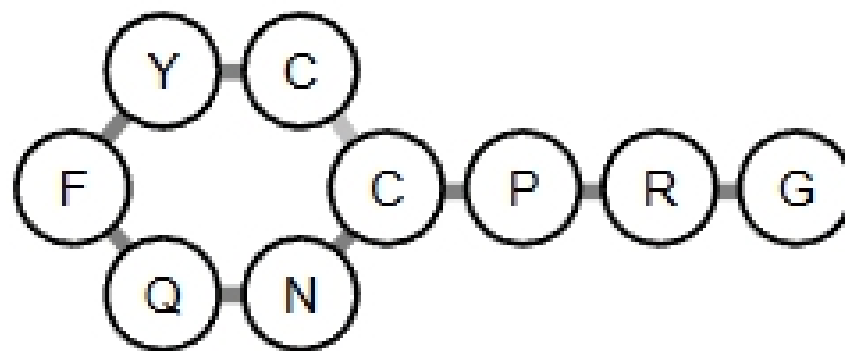
Questions that call for short answers should be limited to 15 words or fewer.

Topic 1	10 pts _____	Topic 5	14 pts _____
Topic 2	24 pts _____	Topic 6	20 pts _____
Topic 3	8 pts _____	Topic 7	12 pts _____
Topic 4	12 pts _____		

TOTAL out of 100 _____

Topic 1.

Vasopressin is a small peptide secreted by the hypothalamus (part of the brain) into the bloodstream. Vasopressin has the following amino acid structure.



The DNA sequence and the mature transcript from the human gene that encodes vasopressin are depicted on Page 9 of this exam. Based on the information provided here and on Page 9, answer the following questions.

1a. (2 pts.) How many exons does this gene have? 3

Name two processes that modify the primary vasopressin transcript to form the mature vasopressin transcript.

1b. (2 pts.) intron splicing

1c. (2 pts.) polyadenylation (also: 5' capping)

Name one post-translational modification that must be occurring if the primary translation product from the gene on Page 9 forms the vasopressin depicted above.

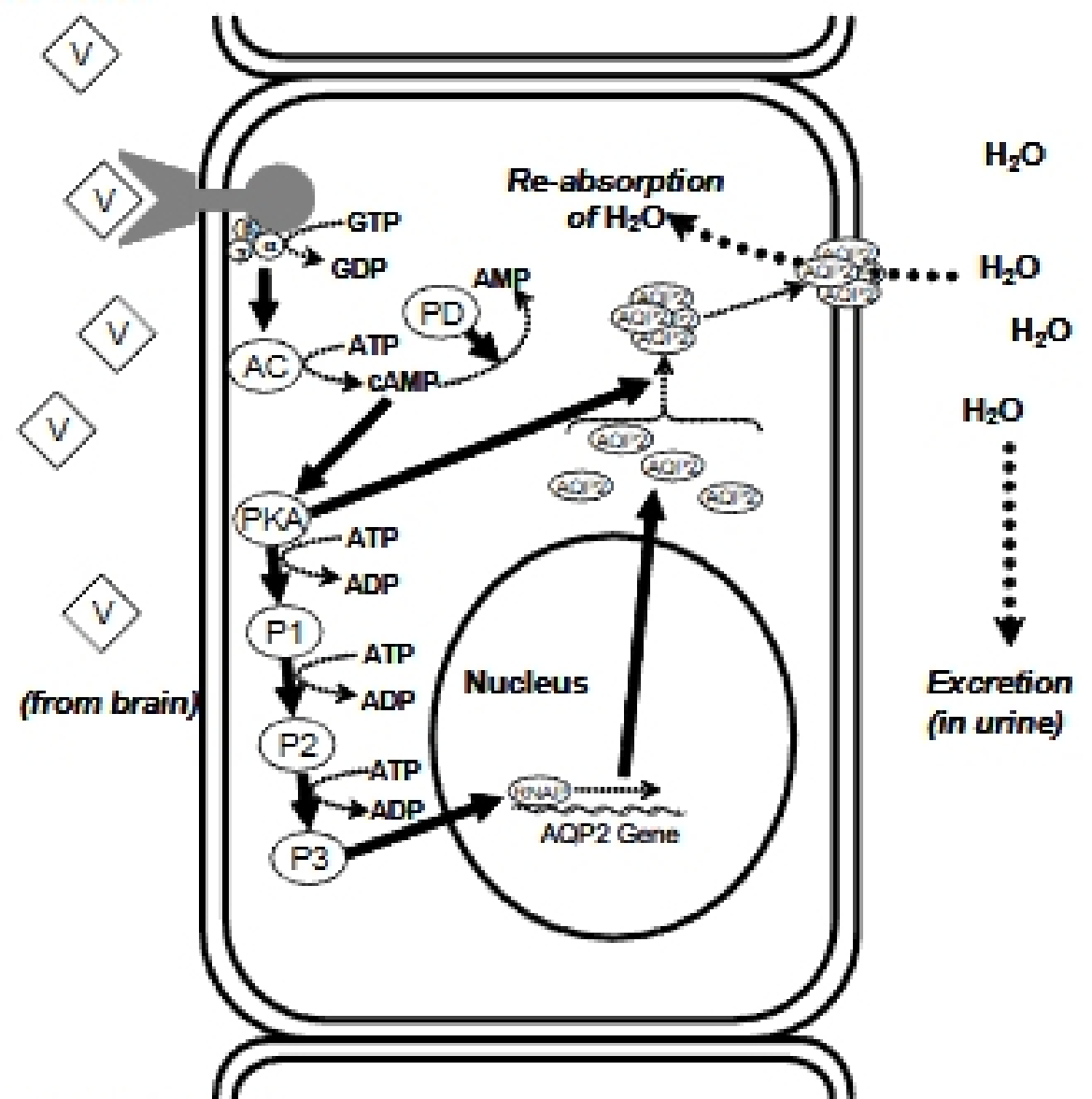
1d. (4 pts.) Proteolytic processing (cleavage of the primary polypeptide)

or Formation of disulfide bond between C (cysteine) residues

Topic 2.

Binding of brain-derived vasopressin to receptors on the surfaces of cells lining the kidneys will activate a signal transduction cascade as depicted here.

Vasopressin (V) signal transduction in kidney cells. Heavy arrows indicate activation of an enzyme, pathway or process. Dotted arrows indicate chemical pathways, processes or movements. Abbreviations: AC = adenylylcyclase; PD = phosphodiesterase; PKA, P1, P2 and P3 = individual enzymes; RNAP = RNA polymerase; AQP2 = aquaporin



2a. (2 pts.) Is the vasopressin/receptor interaction an example of an autocrine, endocrine, paracrine, or amacrine pathway?

endocrine

2b. (2 pts.) What name would best describe the enzyme that metabolizes GTP (indicated by the small circles labeled α , β , γ ?)

G-protein or GTPase

2c. (4 pts.) What is the advantage of having multiple enzymes in a protein kinase cascade?

Signal amplification

2d. (4 pts.) Of all the labeled proteins in the figure, which would best be described as a possible transcriptional activator?

P3

2e. (2 pts.) Only AQP2 tetramers (not monomers) in the cytoplasm form active water channels. The assembly of AQP2 tetramers is a regulated process. Would a chemical that inhibits the phosphorylation of P1 *inhibit*, *enhance* or *have no effect* on the expression of new AQP2 monomers?

inhibit

2f. (2 pts.) Would a chemical that inhibits the phosphorylation of P1 *inhibit*, *enhance* or *have no effect* on the assembly of AQP2 tetramers from previously synthesized monomers?

have no effect

2g. (4 pts.) Of the enzymes and proteins depicted in the above diagram, which one acts to suppress (or weaken) the vasopressin response? Explain in 15 words or fewer.

PD weakens the vasopressin response by lowering the concentration of (metabolizing) cAMP in the cell

2h. (4 pts.) Diabetes insipidus is a disorder in which the hypothalamus fails to produce vasopressin. Based on the diagram above, what would be the most obvious symptom in someone who suffers from diabetes insipidus? Explain in 15 words or fewer.

Frequent or excessive urination; excessive thirst/dehydration