

Here are the quiz 3 questions you will answer online using the quiz tool in canvas instructure. Be sure to note the quiz deadline in canvas to be sure you get your answers submitted by the deadline.

1. Which of the following amino acids (there may be more than one, if so check more than one) would need to be in a protein microenvironment that changes the side chain pK_a value in order to serve as an effective nucleophile for covalent catalysis at pH 7?

- a. asp
- b. glu
- c. ser
- d. lys
- e. tyr
- f. his

2. Which of the following amino acids could be used in a nonmodified form as an electrophile in enzymatic catalysis?

- a. asp and glu
- b. his
- c. arg and lys
- d. lys only
- e. none of the above

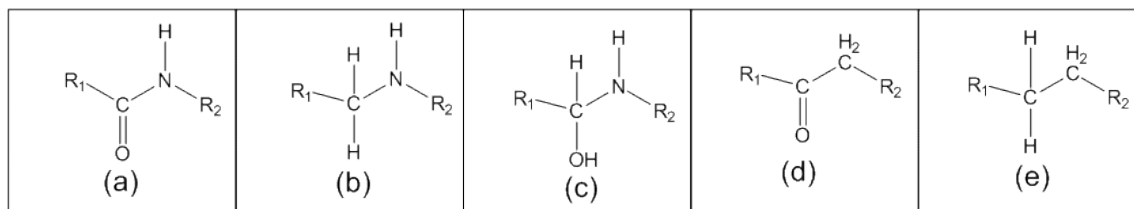
3. Of the following amino acids, which contain(s) a side chain that would NOT be a potential nucleophile for covalent catalysis in an enzyme-catalyzed reaction? Check ALL of the amino acids that are not potential nucleophiles

- a. Phe
- b. Ser
- c. Thr
- d. Tyr
- e. Ala
- f. His
- g. Glu
- h. Gly
- i. Lys

4. For ester bond hydrolysis, the initial attack of water could be accelerated by ____ (i) ____ catalysis, while the breakdown of the tetrahedral intermediate to form products could be accelerated by ____ (ii) ____ catalysis.

- a. (i) general acid; (ii) general base
- b. (i) general base; (ii) general acid
- c. (i) general acid; (ii) general acid
- d. (i) general base; (ii) general base

5. Aspartic proteases catalyze the hydrolysis of peptide bonds in proteins by direct attack of water on the carbonyl carbon in the peptide bond. Which of the following compounds would be most likely to be a good nonreactive transition state analog for aspartic proteases?



6. A Schiff base might be used in a biochemical reaction involving:

- Hydrolysis of an ester or amide
- Cleavage of a carbon-carbon bond
- oxidation/reduction
- ATP hydrolysis
- Interconversion of CO₂ and bicarbonate

7. For the hydrolysis of an ester involving the formation of a tetrahedral intermediate, a metal ion would facilitate the formation of the intermediate via charge ____ (i) _____. For the hydrolysis of ATP, the initial attack of water on the phosphorus of ATP would be facilitated by charge ____ (ii) _____.

- (i) shielding; (ii) stabilization
- (i) stabilization; (ii) shielding
- (i) shielding; (ii) shielding
- (i) stabilization; (ii) stabilization

8. For the hydration of CO₂ to bicarbonate ion catalyzed by carbonic anhydrase, what role does zinc play in the reaction?

- activation of CO₂ as a nucleophile
- lowering the pK_a of water
- activation of CO₂ as an electrophile
- charge shielding
- a general acid/general base

9. In the reaction catalyzed by chymotrypsin, histidine first serves as a general _____, then as a general _____, then as a general _____, then as a general _____.

- base; base; acid; acid
- base; acid; base; acid
- acid; base; acid; base
- acid; acid; base; base
- base; acid; acid; base

10. The catalytic triad of chymotrypsin consists of:

- a. serine, histidine, and aspartate
- b. serine, histidine, and glutamate
- c. aspartate, histidine, and glutamate
- d. tyrosine, serine, and histidine
- e. histidine, threonine, and aspartate

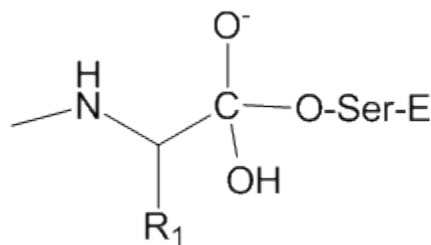
11. The group(s) within the oxyanion hole of chymotrypsin that stabilize transition state(s) and/or intermediate(s) are

- a. positively charged amide hydrogens on the enzyme polypeptide backbone
- b. neutral amide hydrogens on the enzyme polypeptide backbone
- c. positively charged amino acid residue(s) located on the enzyme polypeptide
- d. a divalent metal ion
- e. a coenzyme
- f. both (a) and (c)
- g. both (b) and (c)
- h. both (a) and (b)

12. The oxyanion hole of chymotrypsin is designed to stabilize a ____ (i) ____ oxygen attached to an ____ (ii) ____ hybridized carbon.

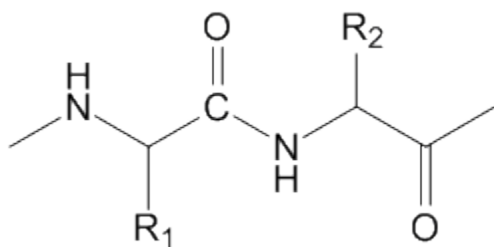
- a. (i) neutral; (ii) sp^2
- b. (i) neutral; (ii) sp^3
- c. (i) negatively charged; (ii) sp^2
- d. (i) negatively charged; (ii) sp^3
- e. both (a) and (d)
- f. both (b) and (c)

13. The following is a substrate or intermediate formed during chymotrypsin-catalyzed polypeptide hydrolysis. The transformation of this compound to the next intermediate or product will involve (check all of the correct answers):



- a. general base catalysis
- b. general acid catalysis
- c. metal ion catalysis
- d. nucleophilic attack using an amino acid side chain as the nucleophile
- e. nucleophilic attack using water as the nucleophile

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15. What is the general name for enzymes that transfer a phosphoryl group from a phosphate monoester to an organic acceptor?

16. What is the general name for enzymes that transfer a phosphoryl group from a phosphate monoester to water?

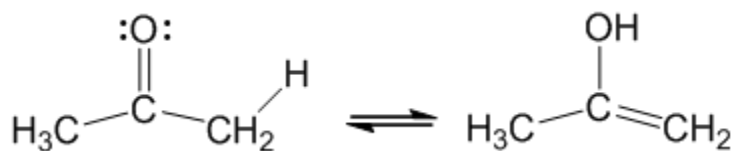
17. What is the general name for enzymes that catalyze the transfer of a phosphoryl group from one position to another within the same molecule?

18. What is the general name for enzymes that transfer a phosphate monoester from a phosphodiester to water?

19. What type of enzyme would transfer AMP from ATP to an organic acceptor?

- a. phosphatase
- b. kinase
- c. nucleotidyl transferase
- d. phosphodiesterase
- e. mutase

20. The following reaction is best referred to as:



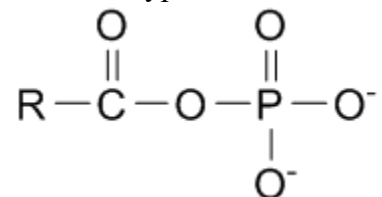
- a. isomerization
- b. resonance stabilization

- c. tautomerization
- d. rearrangement
- e. both (b) and (c)
- f. all of the above apply

21. The extremely large free energy resulting from phosphoenolpyruvate hydrolysis can be largely attributed to which of the following:

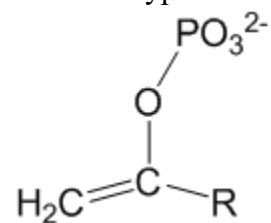
- a. solvation of hydrolysis products
- b. charge separation
- c. product ionization
- d. enol to keto tautomerization
- e. resonance stabilization of products

22. What type of molecule is shown here:



- a. acyl phosphate
- b. phosphoguanidine
- c. enol phosphate
- d. alkyl phosphate
- e. thioester
- f. none of the above

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- a. acyl phosphate
- b. phosphoguanidine
- c. enol phosphate
- d. alkyl phosphate
- e. thioester
- f. none of the above

24. The reaction catalyzed by RNase A follows what type of kinetic mechanism?

- a. random sequential bisubstrate
- b. ordered sequential bisubstrate
- c. ping-pong bisubstrate
- d. single substrate
- e. three substrate ordered sequential

25. To which enzyme(s) do the following principles apply? (choices are chymotrypsin, RNase A, both, or neither)

- a. two base mechanism
- b. pentavalent transition state
- c. hydrogen bonding stabilization of transition state
- d. fixed charge stabilization of transition state
- e. cyclic intermediate
- f. catalytic triad
- g. tetrahedral intermediate
- h. hydrolysis
- i. covalent catalysis
- j. Metal ion catalysis