

University of Canterbury

End-of-year Examinations 2008

Prescription Number(s): CHEM 325
BCHM 302

Paper Title: Biological Chemistry

Time Allowed: Two hours

Number of pages: Seven

This paper is divided into TWO sections.

SECTION A: Answer **TWO** questions out of **THREE**. Worth 50 marks.

SECTION B: Answer **ALL** questions from this section. Worth 50 marks.

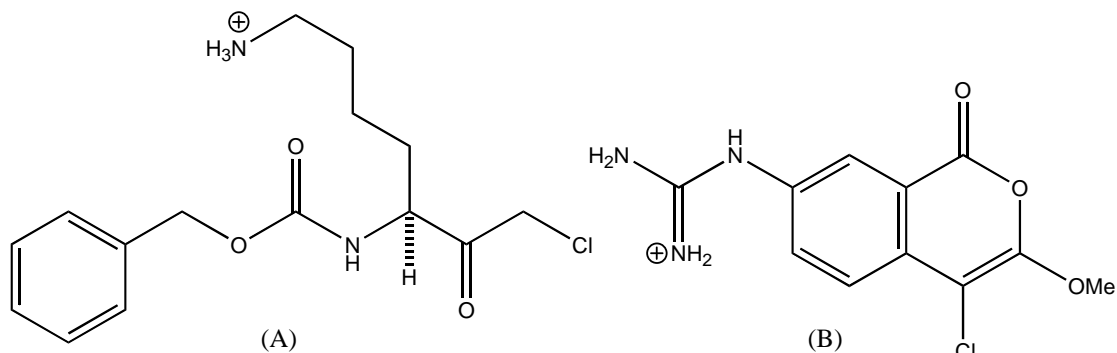
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SECTION A

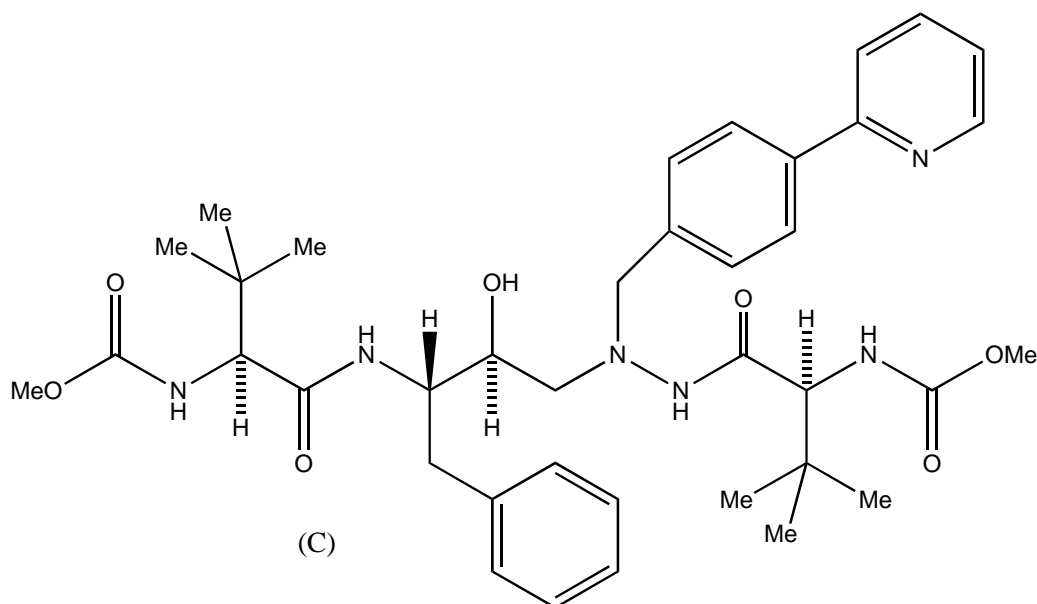
(Answer **TWO** questions from this section.)

1. Give a critical account of the way in which proteins recognize peptides and other proteins. Your account should be illustrated with a range of specific examples, described in molecular detail, and include a discussion of the methodology by which the details of molecular recognition can be determined.
2. Give a critical account of the molecular basis of the selectivity of protease inhibitors. In your account you should include a discussion of (a) and (b).

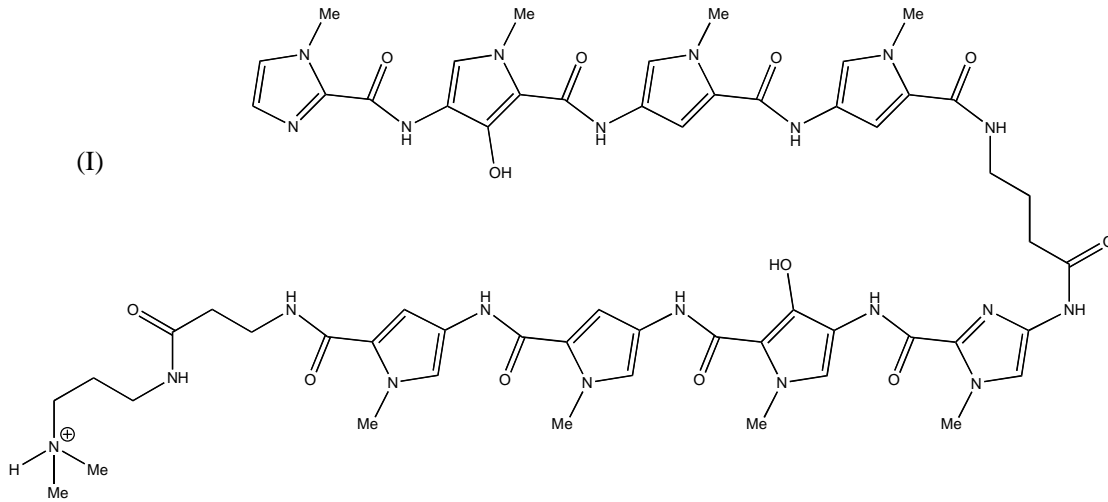
(a) The following two molecules (A) and (B) are both inhibitors of trypsin:



(b) The following molecule (C) is an inhibitor of HIV protease:

**TURN OVER**

3. (a) Describe, in molecular detail, the different ways in which small molecules can bind tightly to DNA. Illustrate your answer with specific examples.
- (b) Compound (I) binds selectively with the DNA duplex (II). Explain the molecular basis for the interaction of (I) with (II).



SECTION B

(Answer **ALL** questions from this section.)

4. (8 marks)

The Michaelis-Menten equation for the rate of an enzyme-catalysed reaction is:

$$v = \frac{k_{\text{cat}}[E]_0[S]}{K_M + [S]}$$

- (a) Define the variables k_{cat} and K_M in this equation and provide common units for these variables.
- (b) Various **assumptions** are made in deriving the Michaelis-Menten equation, including:
- No back reaction occurs;
 - $[S] \sim [S]_0$.

Discuss these assumptions and explain their role in the derivation of the Michaelis-Menten equation.

5. (15 marks)

An inhibitor is a substance that changes the rate of an enzyme-catalyzed reaction. Types of inhibiting action include ‘competitive inhibition’ and ‘noncompetitive inhibition’.

- (a) **Briefly outline** these two mechanisms of inhibitor action.
- (b) If the mechanism of inhibitor action is **noncompetitive**, then the following rate expression holds, where V_{max} , K_M and K_I are kinetic constants:

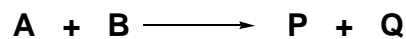
$$v = \frac{\frac{V_{\text{max}}[S]}{\left(1 + \frac{[I]}{K_I}\right)}}{K_M + [S]}$$

Using your mechanism for noncompetitive inhibition from part (a) **show** how this rate expression is derived.

TURN OVER

6. (12 marks)

(a) For the following two-substrate, two-product reaction:

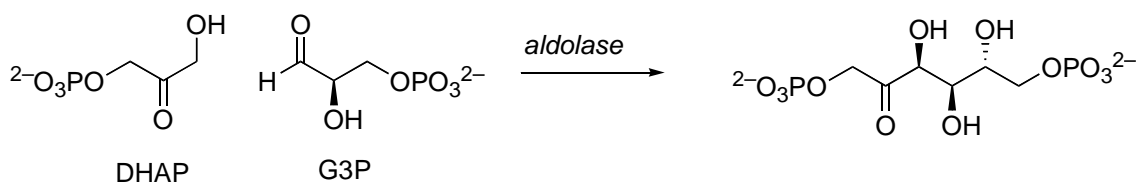


outline the following two kinetic mechanisms and **explain briefly** how these mechanisms can be distinguished by kinetic measurements:

(i) ordered sequential; and

(ii) ping-pong.

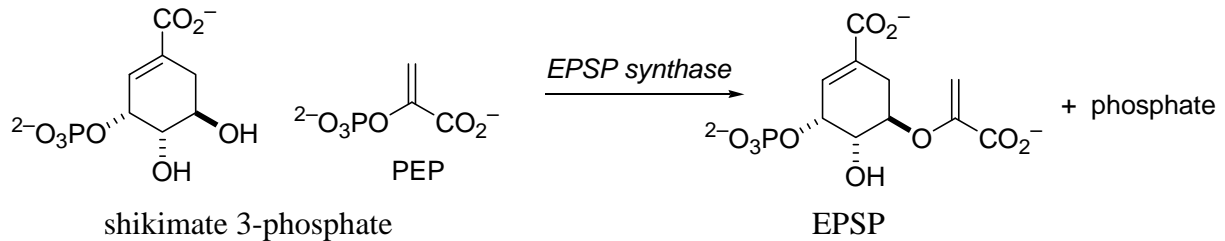
(b) Aldolase catalyses the aldol reaction between dihydroxyacetone phosphate (DHAP) and glyceraldehyde 3-phosphate (G3P).



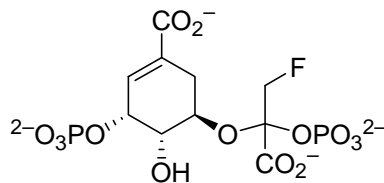
Describe the mechanism of this transformation and use it to **explain** which of the two kinetic mechanisms given in part (a) above most closely resembles the aldolase mechanism.

7. (15 marks)

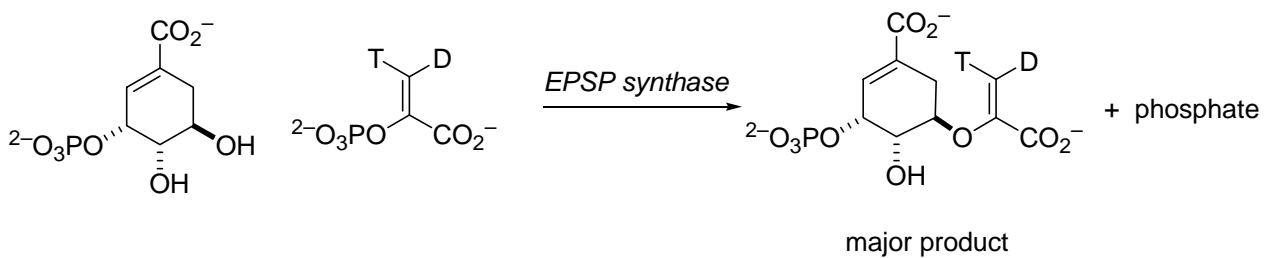
EPSP synthase catalyses the formation of EPSP from shikimate 3-phosphate and phosphoenolpyruvate (PEP). Outline the mechanism of this reaction and use it to explain observations (a) and (b):



(a) When the reaction is carried out with 3-fluoroPEP rather than PEP the following product is formed.



(b) When the reaction is carried out with a specifically deuterium and tritium labelled PEP, predominantly one product is formed (as shown below).



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