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Biochemistry 5700
Fall, 2003
Exam 3

INSTRUCTIONS:

You have two hours to take the exam. The exam should have 11 questions. Answer all questions legibly and completely in the space provided Good Luck!!

Equations: $\Delta G' = \Delta G^{\circ\prime} + RT \ln Q$ $\Delta E' = \Delta E^{\circ\prime} - \frac{RT}{nF} \ln Q$ $\Delta G' = -nFE'$

Constants: F = 96.5 kJ/V•mol R = 8.3144 J/mol•K

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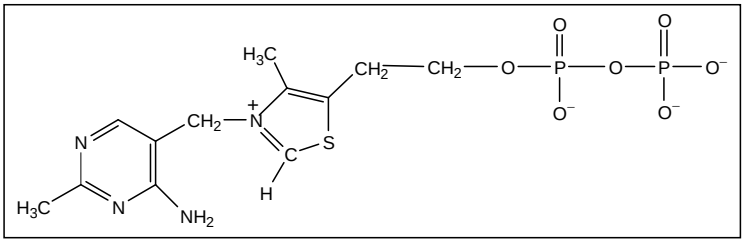

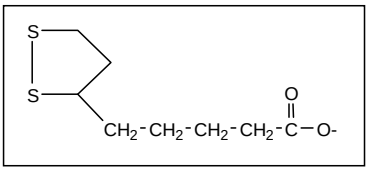

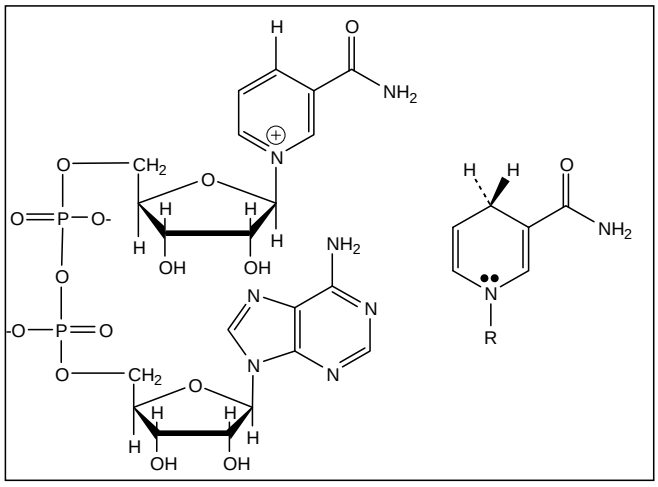

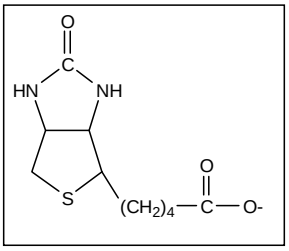

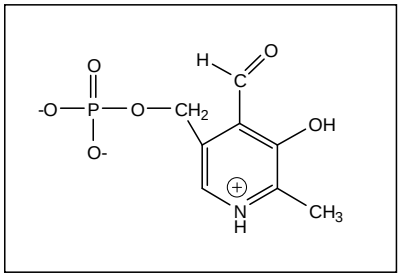

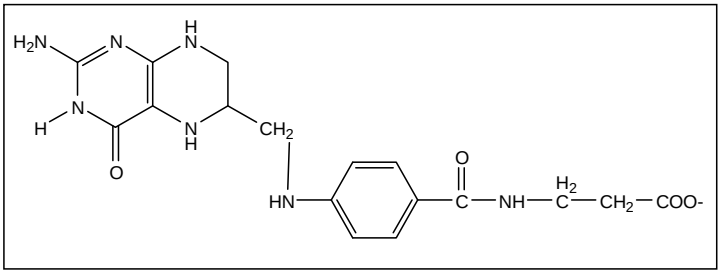

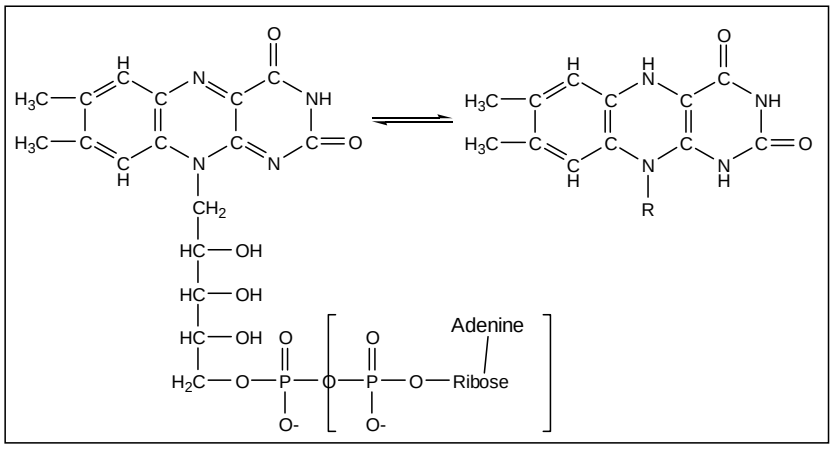

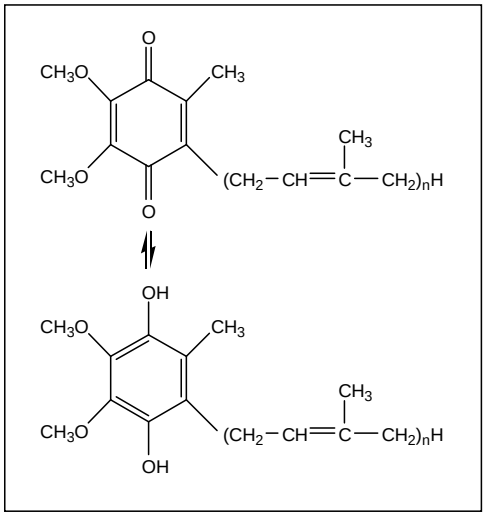

(1) (10 points) For each of the following, name a specific "transporter" representing that type, and name the molecule(s) transported:

Transport type	Name of transporter	molecule(s)
(a) passive uniport		
(b) passive antiport		
(c) primary active transport: ATP driven		
(d) primary active transport: light driven		
e) secondary active transport		

(2) (4 points) What are the differences between a transporter and an ion channel?

(3) (4 points) What is the physiological role of the sodium-potassium ATPase?

(4) (20 points) For the following general classes of reaction, name a specific enzyme from central metabolism catalyzing that type of reaction, write the complete reaction catalyzed by the enzyme (note-structures and mechanism are not required-just names), and list any cofactor(s) used by that enzyme.

Reaction type	**Enzyme**	**Balanced equation with necessary cofactor(s) listed above arrow**
claisen condensation		
elimination		
intramolecular phosphoryl transfer		
aldo-keto isomerization		
substrate-level phosphorylation		
FAD-dependent dehydrogenation (no other cofactors)		
NAD^+-dependent dehydrogenation (no other cofactors)		
nonoxidative alpha-keto acid decarboxylation		
oxidative alpha-keto acid decarboxylation		

NADP+-dependent dehydrogenation		

(5) (15 points) Complete the enzyme-catalyzed reaction mechanisms (from left to right), with appropriate intermediates, acids/bases, cofactors, and electron pushing arrows:

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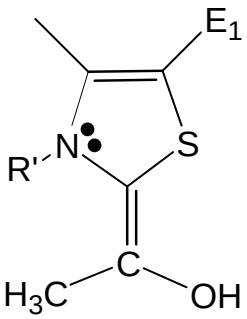

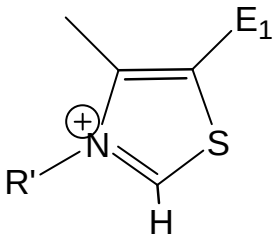

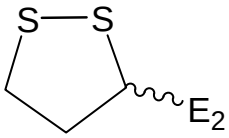

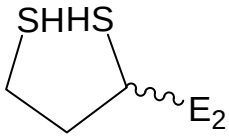

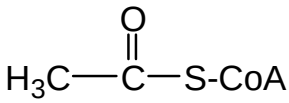

(6) (12 points) The ability to stabilize carbanions is an important feature of many metabolic enzymes. What are two different strategies an enzyme might employ, in the absence of an exogenous cofactor like TPP, to stabilize a carbanion generated during catalysis? Use specific examples from glycolysis and/or the citric acid cycle in answering the question.

(7) (6 points) Write the balanced chemical equations for fermentation of glucose to (a) lactate and (b) CO_2 and ethanol.

(8) (4 points) Write the balanced chemical equation for one turn of the citric acid cycle (starting with acetyl-CoA).

(9) (10 points) Describe the sequence of events involved in the hormonally-controlled mobilization of stored glycogen as an energy source.

(10) (4 points) Glycogen phosphorylase in the liver is a glucose/AMP (circle one) sensor, and binds this metabolite in the phosphorylated/unphosphorylated (circle one) form. In contrast, glycogen phosphorylase in the muscle is a glucose/AMP (circle one) sensor and binds this metabolite in the phosphorylated/unphosphorylated (circle one) form.

(11) (11 points) Some chemoautotrophic bacteria gain all their energy from the oxidation of ammonia to nitrite (a **six electron** process). In theory at least (biochemical standard state conditions), the free energy provided by the **oxidation of <u>one mol</u> NH_3** in the presence of O_2 is sufficient to form how many mols of ATP?.
($E\,°' = +0.34$ V for the NO_2^-/NH_3 couple, $E\,°' = +0.816$ V for the O_2/H_2O couple, $\Delta G\,°' = -30.5$ kJ/mol for ATP hydrolysis)