Abbreviated Answers to Example Exam-II

Question #1

(a) synthase or lyase

(b) One molecule of carbonic anhydrase coverts (turnsover) 1.5 x 10^5 molecules of CO_2 to product every second under saturation conditions.

(c)

(i) Vmax = 5.88 mmol/min = 9.8 x 10^{-5} mol/sec, E = 6.5 x 10^{-10} mol = 19.5 µg.

(ii) Km = 5.88 mmol/min x 1.5 min/L = 8.8 mM

(iii) Km represents the [S] required to maintain 50% filling of the enzyme active sites during the course of the enzyme assay and thus yield a reaction rate, v = 1/2 Vmax.

(d) (i) No **(ii)** If the inhibitor was binding non-covalently in the active site one should be able to to overcome the inhibition by using a high concentration of substrate. The graph indicates increasing the concentration of [S] does not overcome the effect of the inhibitor, that is, the lower (+I) curve does not approach the upper (-I) curve as the [S] is increased. This is not consistent with competetive inhibition.

Question # 2

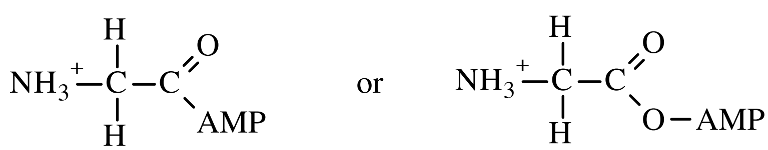
(a) ΔG' = + 5.7 kJ/mol

(b) Qcell' cannot equal or exceed 3.78 x 10^4

(c) Step #1: Carboxylate-O^- of N-terminal glycine = nucleophile; PPi = leaving group

Step #2: NH_2 (not NH_3^+) of C-terminal glycine = nucleophile; AMP = leaving group

(d) Can indicate in two ways:



Question #3

(a) 1 and 0

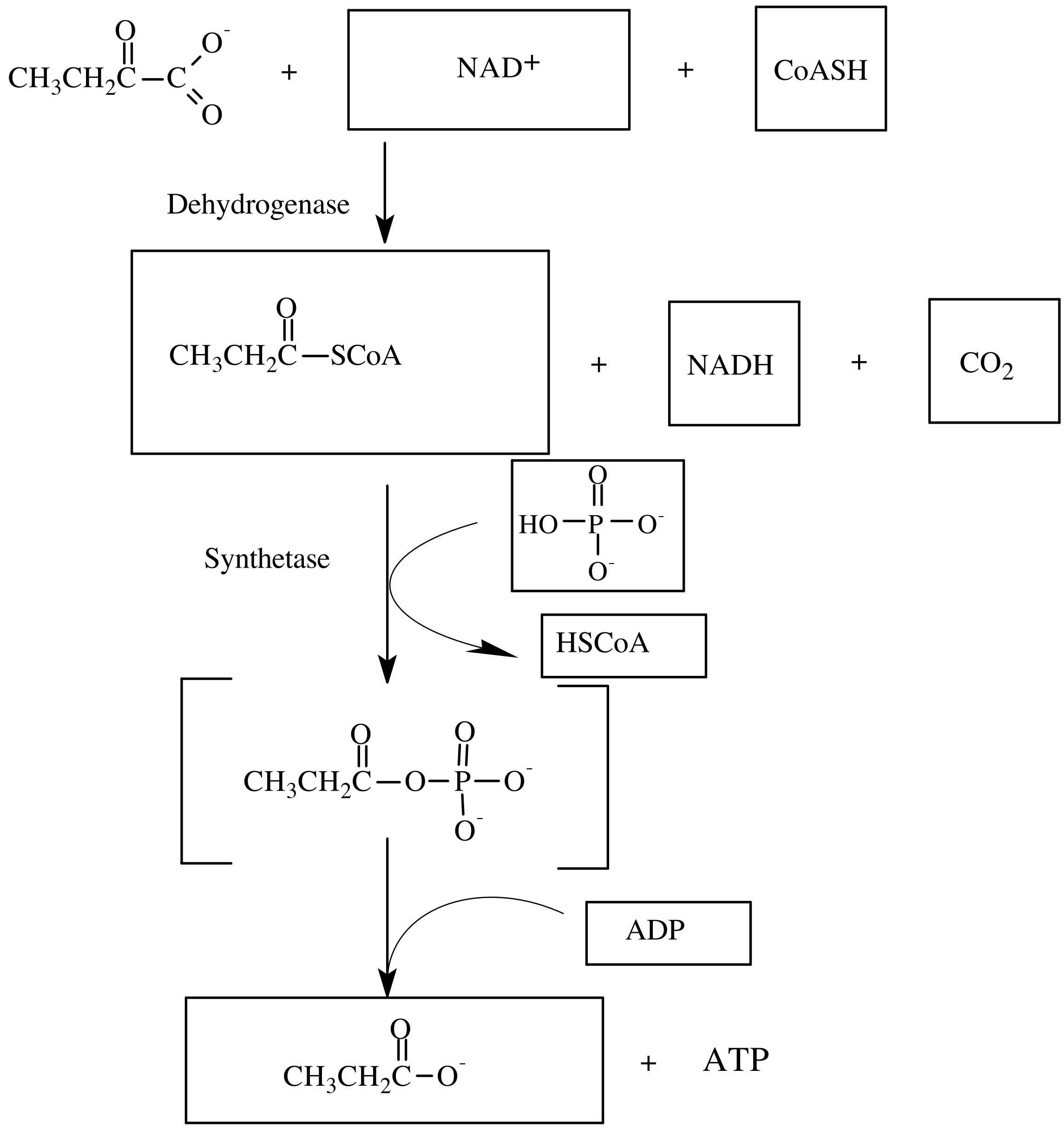
(b) (i) Cytochrome c or Complex 4. **(ii)** For both components 1:1 (using $4H^+$/ATP) or 1:33:1 (using $3H^+$/ATP) for part marks.

(c) (i) Yes. Work to synthesize 4 mol of ATP = 126 kJ. Energy from oxidation of 1 mol of Vitamin C = 146.2 kJ. Since 146.2 > 126 kJ there is enough energy to do the work required with enough left over to give the overall process a ΔGº' < 0.

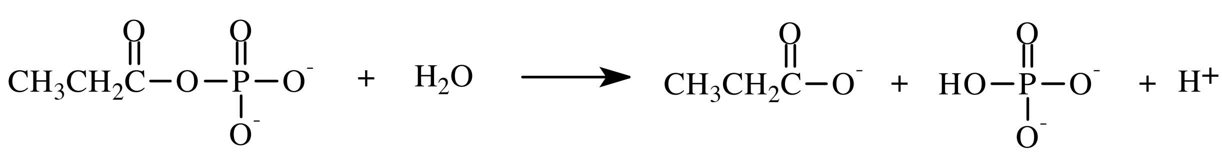
(ii) ΔG'= 2476 ln ($10^{-7}/10^{-6}$) + (+1)(96, 480)(-0.18) = -23.0 kJ/mol H^+ transported. 23.0 kJ of energy produced/mol H^+ transported x 3 mol H^+ = 69 kJ energy produced

Question #4

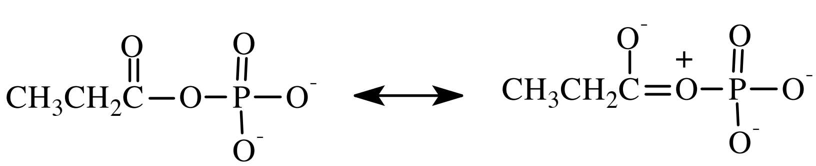
(a)



(b)(i)

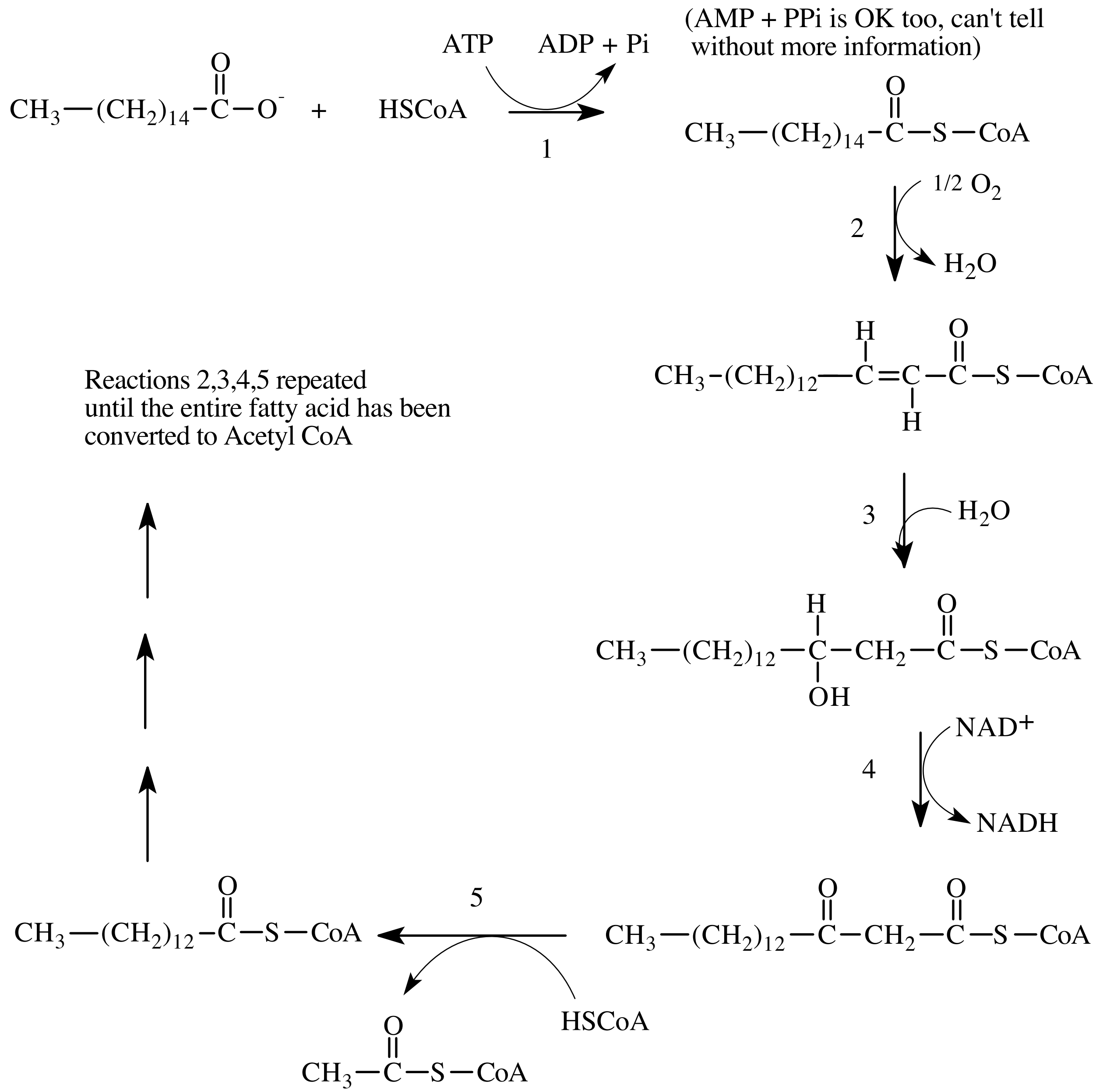


(ii)



Question #5

(a)

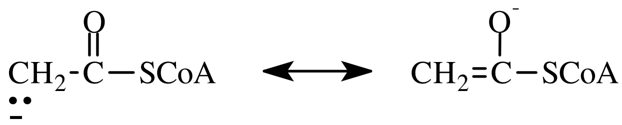


(b) Pantothenic acid

(c)

Reaction	Reaction similar to which Glycolysis or TCA cycle reaction?	Systematic enzyme name (1 word)	Names of any vitamin(s) involved in reaction
1	TCA-5	Synthetase	None
2	TCA-6	Dehydrogenase	Riboflavin
3	TCA-7	Synthase or Lyase	None
4	TCA-8	Dehydrogenase	Niacin

(d) (1) Stabilized by resonance



(2) There will also be a (+) charged active site residue or metal cation (Mg^{+2}, Zn^{+2} etc.) prosthetic group involved in stabilizing the negative charge on the carbanion

(e)

16C Fatty acid ⟶ 8 acetyl CoA

SLP = 0

Oxphos

Rxn #2 (like succinate dehydrogenase rxn of TCA/ETC)	7 x 1.5 = 10.5
NADH	7 x 2.5 = 17.5

8 acetyl CoA ⟶ 16 CO_2 (TCA cycle)

SLP	8 x 1 = 8
Oxphos	
NADH	24 x 2.5 = 60
Succinate	8 x 1.5 = 12
	Total =108

But used 1 ATP so net synthesis of ATP = 108-1 = 107

Question #6

(a) Yes, IDH is an allosteric enzyme. This conclusion is derived from an examination of the shape of its activity (v_o versus [S]) curve. It is sigmoidal which indicates cooperative S binding by a multisubunit enzyme.

(b) ATP is a negative effector (or allosteric inhibitor) because when ATP is added, a decrease in rxn rate is seen at all [S=isocitrate] in the presence of ATP.

(c) The IDH reaction yields NADH which is used to make ATP by oxidative phosphorylation. When the [ATP] is high, this indicates ATP exceeds the needs of the cell. By using ATP as an inhibitor of IDH unneeded NADH and thus unneeded ATP is not made.

(d) ADP is a positive effector (or allosteric activator) because when ADP is added an increase in rxn rate is seen at all [S]=[isocitrate] in the presence of ADP.

(e) The IDH reaction yields NADH which is used to make ATP by oxidative phosphorylation. When the [ADP] is high, this indicates the cell's needs for ATP exceeds the supply. By using ADP as an activator of IDH more NADH and thus more ATP is made to satisfy the cells needs for ATP.

(f) Far-from equilibrium. Based on its activity curve and response to ATP and ADP, IDH is an a regulatory enzyme. Reactions catalyzed by regulatory enzymes operate far from equilibrium. This is because even though under [S]s prevailing in the cell, regulatory enzymes catalyze their reaction rates near Vmax, these Vmaxs are not high in absolute terms. In other words, rxns catalyzed regulatory enzymes are kept from reaching equilibrium because of their low intrinsic activity.