Chemistry 2710 Problem Set on Enzyme Inhibition

1. Consider the following enzyme competitive inhibition data:

$i_0 = 0$					
s (μmol/L)	41.7	125	208	292	375
v (μmol L^{-1}s^{-1})	248	447	532	580	610

$i_0 = 9.02$ mmol/L					
s (μmol/L)	41.7	125	208	292	375
v (μmol L^{-1}s^{-1})	186	373	466	522	559

$i_0 = 18.0$ mmol/L					
s (μmol/L)	41.7	125	208	292	375
v (μmol L^{-1}s^{-1})	149	319	414	474	516

$i_0 = 27.1$ mmol/L					
s (μmol/L)	41.7	125	208	292	375
v (μmol L^{-1}s^{-1})	124	279	373	435	479

   Calculate $v_{\max}$, K_S and K_I.

2. In bacteria, phosphoglucose isomerase catalyzes the transformation of fructose-6-phosphate into glucose-6-phosphate (or vice versa), allowing the cell to select between two different fermentative pathways according to the prevailing conditions. This selection requires a metabolic switch, i.e. a means of turning the activity of phosphoglucose isomerase on or off. This can be accomplished if appropriate metabolites (intermediates in biochemical pathways) inhibit the enzyme. Richter and coworkers have studied the inhibition of phosphoglucose isomerase from *Oenococcus oeni* by metabolites of the two fermentative pathways.[1] In particular, for the conversion of fructose-6-phosphate (F6P) to glucose-6-phosphate in the presence of varying concentrations of erythrose-4-phosphate (E4P), the following data were obtained:

[1] H. Richter, A. A. De Graaf, I. Hamann and G. Unden, Arch. Microbiol. **180**, 465 (2003). I would like to thank Professor Unden for making his raw data available.

[F6P]/mmol L^{-1}	v/μmol g^{-1}min^{-1}				
0.2	132	74	75	30	18
0.5	283	205	183	97	43
1	392	257		155	92
1.5	471	398	325	243	132
2	525	434	373	296	169
5	560	551	435	374	250
7	580	581	396	380	280
10	640	591	448	439	336
[E4P]/μmol L^{-1}	0	1.5	3	4.5	6

These data were generated from a cell extract rather than a purified enzyme, so the rates were normalized by the dry weight of the preparation, hence the units given above.

Determine whether these data exhibit competitive or uncompetitive kinetics, or neither. If the type is competitive or uncompetitive, determine the values of K_S,[2] K_I and $v_{\max}$. Otherwise, explain exactly how you reached your negative conclusion.

[2] ... or K_E. Whether you call the Michaelis constant of the uninhibited enzyme K_S or K_E just depends on whether you used the steady-state or equilibrium approximation to derive the rate equation.