1.

$$E + S \underset{k_a'}{\overset{k_a}{\rightleftharpoons}} ES \xrightarrow{k_b} E + P$$

$$E + S^* \underset{k_a'^*}{\overset{k_a^*}{\rightleftharpoons}} ES^* \xrightarrow{k_b^*} E + P$$

(1) 낮은 기질 농도에서의 속도가 eqn(26.20a)으로 주어진다. S^*에 대해서도 마찬가지다.
eqn(26.23)과 (26.24)에 따르면, $K_M=(k_a'+k_b)/k_a$ 이므로,
$v=\{k_ak_b/(k_a'+k_b)\}[S]_0[E]_0=(k_b/K_M)[S]_0[E]_0$
∴속도의 비는 $k_bK_M^*/k_b^*K_M$ 또는 $k_{cat}K_M^*/k_{cat}^*K_M$
높은 농도에서의 비는 k_b/k_b^* 또는 k_{cat}/k_{cat}^*

(2) 전체 효소 농도는, $[E]_0=[E]+[ES]+[ES^*]$
정류 상태 방정식들은 다음과 같다.
$k_a[E][S]-(k_a'+k_b)[ES]=0$
$k_a^*[E]\{[S^*]-(k_a'^*+kb^*)[ES^*]=0$
그리고, $[E]_0=[ES](K_M/[S]+1+[S]K_M/[S^*]K_M^*)$
여기에서 $K_M=(k_a'+k_b)/k_a$ 이고 $K_M^*=(k_a'+k_b^*)/k_a^*$ 이다.

$$V=k_b[ES]=\frac{k_b[E]_0}{K_M/[S]+1+[S^*]K_M/[S]K_M^*}=\frac{k_b^*[E]_0[S^*]}{K_M^*(1+[S]/K_M+[S^*]/K_M^*)}$$

S*로부터 생성물의 생성속도도 비슷하게 다루면, 다음과 같은 답이 된다.

$$v^*=k_b^*[S]=\frac{k_b^*[E]_0[S^*]}{K_M^*(1+[S]/K_M+[S^*]/K_M^*)}$$

S와 S* 농도가 같을 때, 두 속도의 비는

$$v/v^*=\frac{k_b/K_M}{k_b^*/K_M^*}$$

2. (1) $\langle n\rangle = 2\nu = 2k[M][I]^{-\frac{1}{2}}$

$\langle n_1\rangle : \langle n_2\rangle = 2k[M][I_1]^{-\frac{1}{2}} : 2k[M][I_2]^{-\frac{1}{2}}$

$200 : 300 = 0.01^{-\frac{1}{2}} : [I_2]^{-\frac{1}{2}}$

$[I_2]^{-\frac{1}{2}} = \frac{300 \times 0.01^{-\frac{1}{2}}}{200}$ $\therefore [I_2] = 4.4 \times 10^{-3}\,M$

(2) $p = \frac{kt[A]_0}{1+kt[A]_0}$

$\langle n\rangle = \frac{[A_0]}{[A]} = \frac{1}{1-p} = 1 + kt[A]_0$

$100 = 1 + k(100min)[A]_0 \rightarrow k[A]_0 = 9.9$

$200 = 1 + 9.9t$

$t = \frac{199}{9.9} = 20.1\,(min)$

3. (1) $E = \frac{N_A h c}{\lambda} = \frac{(6.02 \times 10^{-23}/mol)(6.62 \times 10^{-34}\ J\cdot s)(3 \times 10^{8}\ m/s)}{(435.8 \times 10^{-9}\ m)}$

$= 2.74 \times 10^{5}\ J/mol.$

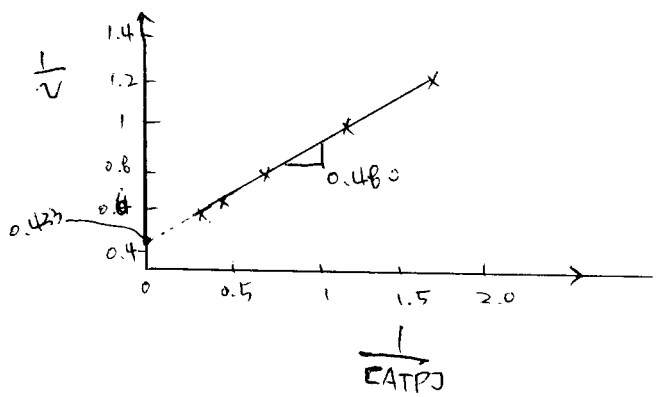
$I_{abs} = \frac{(1.4 \times 10^{-3}\ J/s)(0.801)}{(2.74 \times 10^{5}\ J/mol)(1L)} = 4.09 \times 10^{-9}\ mol/L\cdot s$

(2) $v = \frac{7.5 \times 10^{-9}\ mol/L}{1105\ s} = 6.79 \times 10^{-8}\ mol/L\cdot s$

$\phi = \frac{v}{I_{abs}} = \frac{6.79 \times 10^{-8}\ mol/L\cdot s}{4.09 \times 10^{-9}\ mol/L\cdot s} = 16.6$

4. (1) Lineweaver – Burk plot ($\frac{1}{v}$ vs. $\frac{1}{[S]_0}$)

$[ATP]/\mu mol\cdot dm^{-3}$	0.60	0.80	1.4	2.0	3.0
$v/\mu mol\cdot dm^{-3}\cdot s^{-1}$	0.81	0.97	1.30	1.47	1.69
$1/[ATP]$	1.67	1.25	0.714	0.50	0.333
$1/v$	1.23	1.03	0.769	0.680	0.592



(2) $\frac{1}{v_{max}} = y - \text{Intercept} = 0.433\ (\mu mol/dm^3\cdot s)^{-1}$

$\therefore V_{max} = 2.31\ \mu mol/dm^3\cdot s$

$k_b = \frac{V_{max}}{[ATP]_0} = \frac{2.31\ \mu mol/dm^3\cdot s}{0.02\ \mu mol/dm^3} = 115/s$

$k_{cat} = k_b = 115/s$

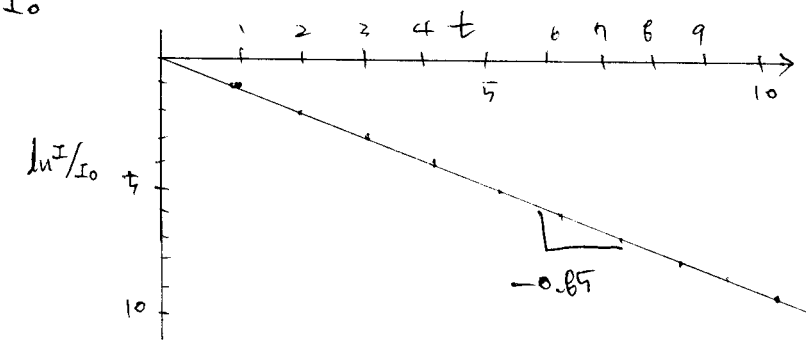
$K_m = V_{max} \times \text{Slope} = (2.31\ \mu mol/dm^3\cdot s)(0.480\ s) = 1.11\ \mu mol/dm^3$

$\varepsilon = \frac{k_{cat}}{K_m} = \frac{115/s}{1.11\ \mu mol/dm^3} = 104\ dm^3/\mu mol\cdot s$

5. $I = I_0 \exp(-t/\tau)$

$\ln \frac{I}{I_0} = -t/\tau$

t (s)	0	1	2	3	4	5	10
I (intensity)	100	43.5	18.9	8.2	3.6	1.6	0.02
I/I_0	1	0.435	0.189	0.082	0.036	0.016	0.0002
$\ln I/I_0$	0	-0.833	-1.666	-2.501	-3.324	-4.135	-8.517



(1) $-\frac{1}{\tau} = \text{slope} = -0.85/s$

$\tau = 1.17 s.$

(2) phosphorescence

since the life time of fluorescence is less than 10^{-6} sec and that of phosphorescence is higher than 10^{-3} sec.