Problem 4-01 Saturation curve, constants of Michaelis-Menten equation

Using experimental values of the initial reaction rates for various substrate (L-tryptophan ≡ S) concentrations (see the table),
(a) draw the saturation curve,
(b) find the values of Michaelis constant K_M and limiting rate v_{max} of enzymatic reaction

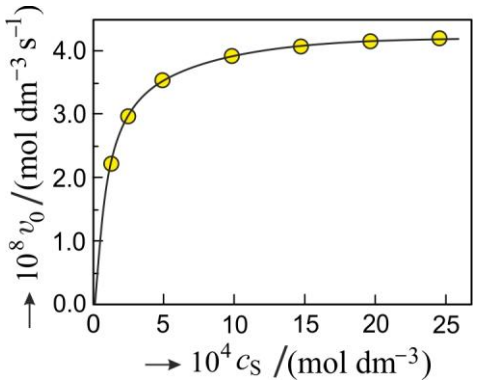
L-tryptofan + H_2O = indol + pyrurvate + NH_3

$10^4\ c_S$ (mol dm^{-3})	$10^8\ v_0$ (mol dm^{-3} s^{-1})
0.8	1.760
1.22	2.218
2.45	2.953
4.90	3.534
9.79	3.920
14.69	4.068
19.59	4.146
24.48	4.194

[(a) Saturation curve – plot v_0 *vs.* c_S
(b) $v_{max} = 4.4 \cdot 10^{-8}$ mol dm^{-3} s^{-1}, $K_M = 1.2 \cdot 10^{-4}$ mol dm^{-3}]

Solution:

(a) Saturation curve – plot v_0 *vs.* c_S:



(b) Correlation by linearized Michaelis and Menten equation (Lineweaver and Burk)

$$\frac{1}{v_0} = \boxed{\frac{1}{v_{max}}} + \left[\!\left[\frac{K_M}{v_{max}}\right]\!\right] \cdot \frac{1}{c_S} \qquad (1)$$

$10^{-3}\ 1/c_S$ (dm^3 mol^{-1})	$10^{-7}\ 1/v_0$ (dm^3 mol^{-1} s)
12.50	5.682
8.20	4.508
4.08	3.386
2.04	2.829
1.02	2.551
0.68	2.458
0.51	2.412
0.41	2.384

Linear regression:

$$\frac{1}{v_0} = \boxed{2.27271 \cdot 10^7} + 2727.3 \cdot \frac{1}{c_S} \qquad (2)$$

Comparison of equation (1) and (2):

$$v_{max} = \frac{1}{2.27271 \cdot 10^7} = 4.4 \cdot 10^{-8} \text{ mol dm}^{-3} \text{ s}^{-1}$$

$$\frac{K_M}{v_{max}} = 2727.3$$

$$\Rightarrow K_M = 2727.3 \cdot 4.4 \cdot 10^{-8} = 1.2 \cdot 10^{-4} \text{ mol dm}^{-3}$$