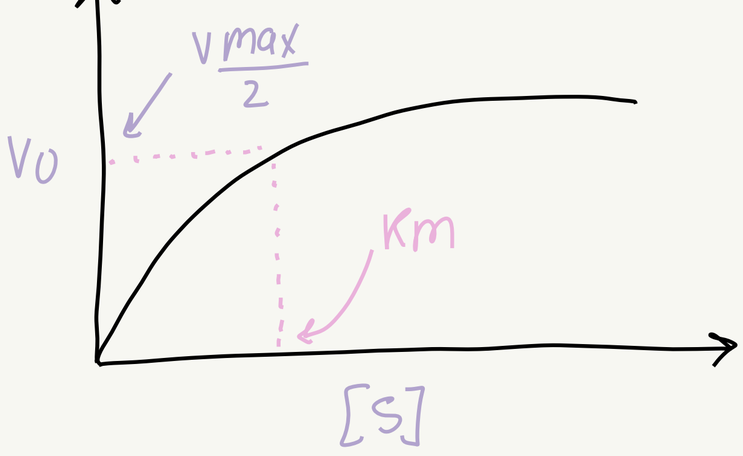


the product don't converted back to S.

$$E + S \underset{K_2}{\overset{K_1}{\rightleftharpoons}} ES \xrightarrow{K_3} E + P$$

Substrate + Enzyme $\underset{K_2}{\overset{K_1}{\rightleftharpoons}}$ E-S complex (Michaelis complex) $\xrightarrow{K_3}$ Enzyme + product

K_1: rate constant of ES formation

K_2 rate constant of ES dissociation to E & S.

K_3: rate constant of ES complex dissociation to E & P.

$$V_0 = \frac{V_{max}[S]}{K_m + [S]}$$

$$K_m = \frac{K_2 + K_3}{K_1}$$

* Vmax & Km Constant for the Enzyme we can determine them Experimentally .WE for each enzyme

نفترض

if we Suppose that [S] = Km

$$V_0 = \frac{V_{max}.[S]}{K_m + [S]} \longrightarrow \frac{V_{max}.K_m}{K_m + K_m} \longrightarrow \frac{V_{max}.K_m}{2K_m} = \frac{V_{max}}{2}$$

$$\therefore \boxed{V_0 = \frac{1}{2} V_{max}}$$

* So, we can define Km as the [S] required to reach $\boxed{1/2\ V_{max}}$

Example// if we said that Km for Enzyme A is 100 mM, what does that mean?

* it means that Enzyme -A- requires 100 mM of its Substrate to reach 1/2 of its Vmax.

* Km is an indication for the affinity between the Enzyme and its Substrate

طيب أول بس نتو بحكي "Affinity".

Affinity: هو قدرة الإنزيم إنه يرتبط مع جزيء واحد بوجود الجزيئات الأخرى.

High Km → Low affinity

Low Km → High affinity.

* High Km يعني (high $K_2 + K_3$) → faster dissociation of ES complex → less Stable

* Low Km → (Low $K_2 + K_3$) → Slower dissociation of ES complex → more Stable.

أيضاً تفككًا ← أكثر استقرارًا ..

$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_3} E + P$$

$k_2 + k_3$ → تفكك

k_1 → تكوّن

من المعادلة

$$\frac{\text{Rate Constant of ES Complex Dissociation}}{\text{Rate Constant of ES Complex Formation}} = K_m$$

من هاد الإستنتاج بقدر احكي إنّه ال Km =

$K_m = \frac{k_2 + k_3}{k_1}$, High Km → high $(k_2 + k_3)$ → تفككه <u>أسرع</u> من تكوّنه

Low Km → Low $(k_2 + k_3)$ → تفككه <u>أبطأ</u> من تكوّنه

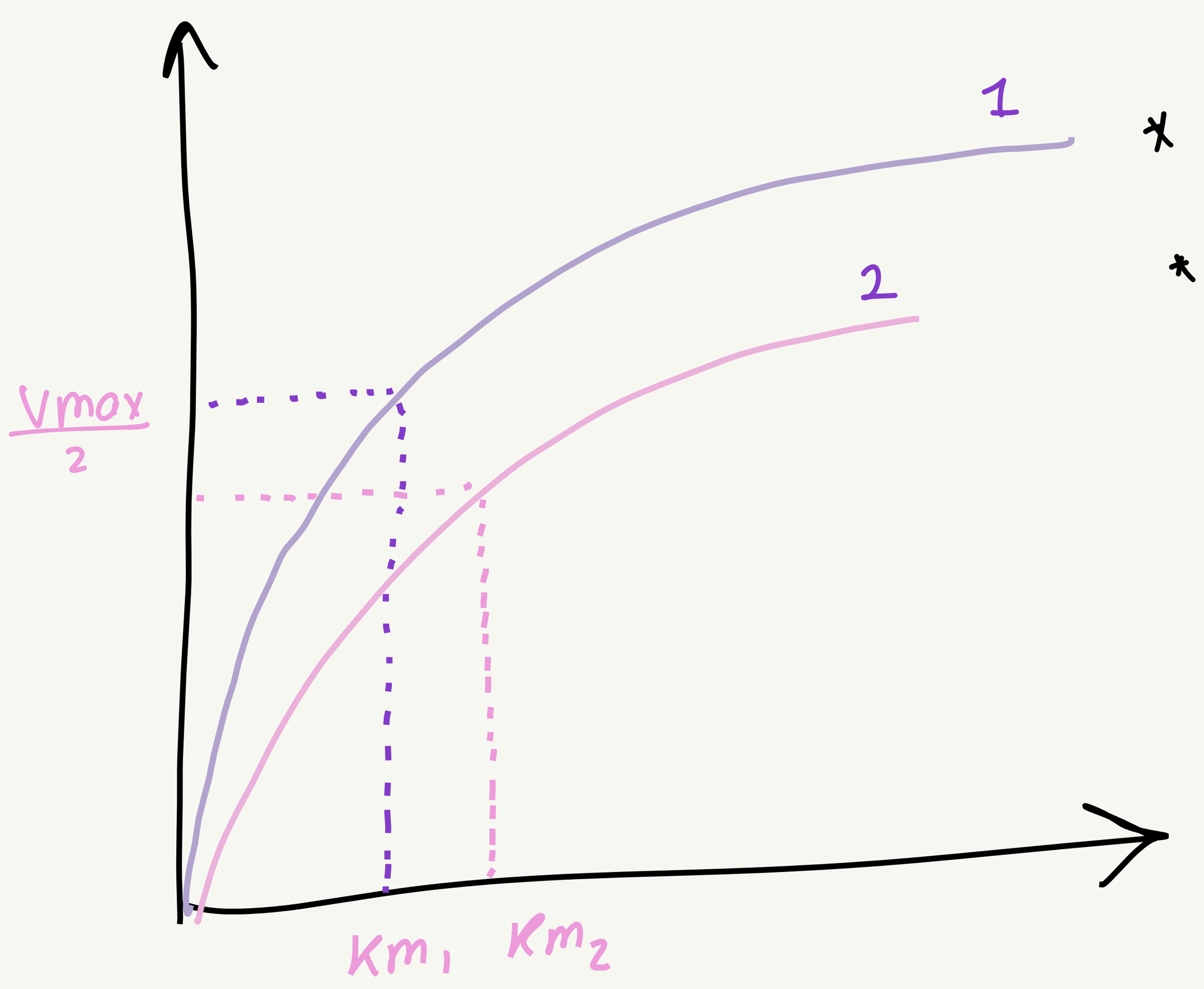
Question :) which of the following Enzyme has highest affinity to its substrate

Catalyse , Km = 25

Hexokinase , Km = 0.4

chymotrypsin , Km = 108

<u>Hexokinase</u> بس بكل بساطة بحكي الي أقل Km الي هو ال

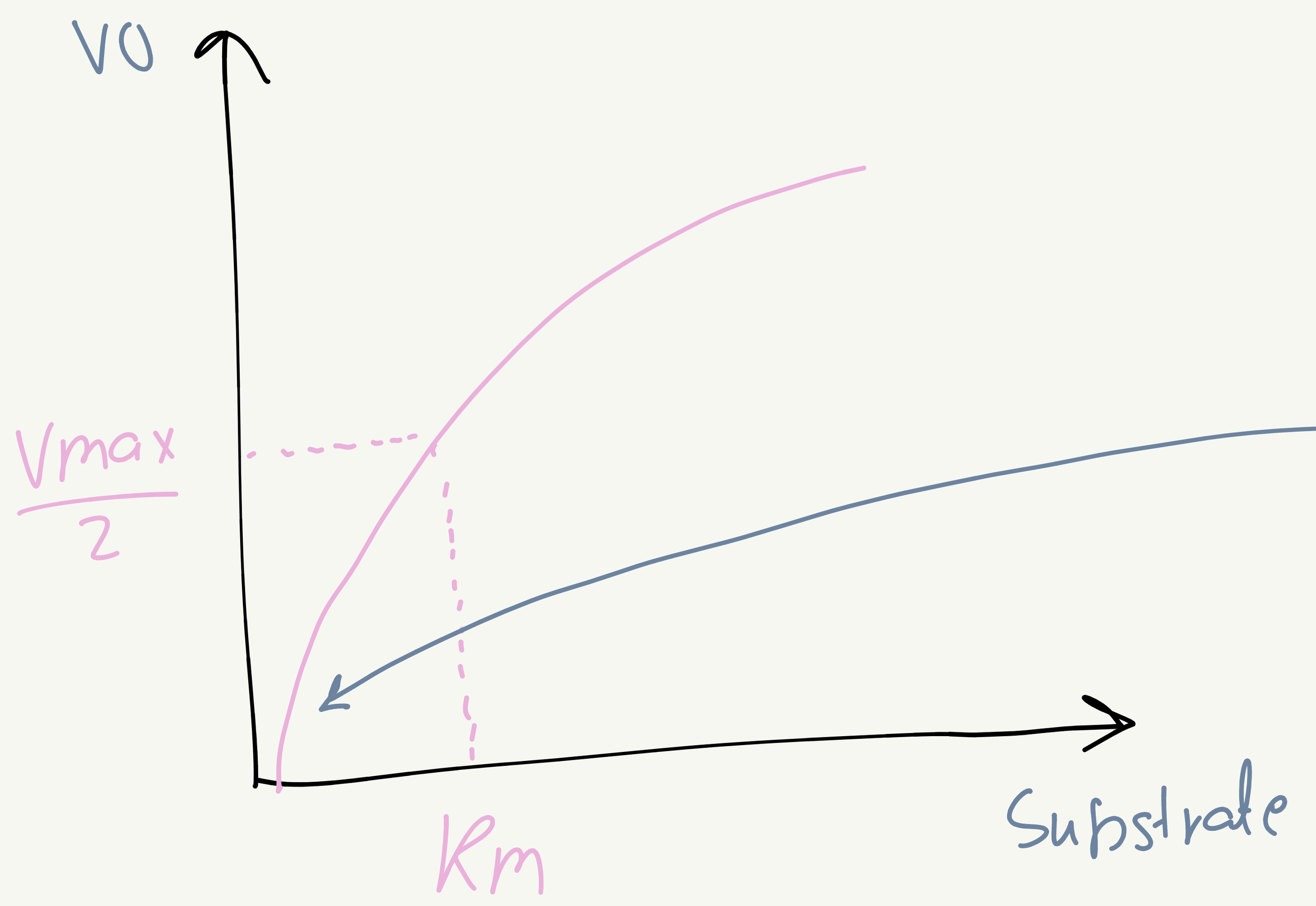


* Km High → Affinity Low → Substrate Conc. ↑
* Km Low → Affinity High → Substrate Conc. ↓

At Low Substrate Conc. $[S] \ll Km$ → first Order (Linear) بعتمد على تركيز S

At High Substrate conc. $[S] \gg Km$ → the Enzyme Saturated , $V_0 \approx Vmax$ Zero Order

ما بعتمد على تركيز S



Low Conc of S ($S \ll Km$) → first order

$Vo < \frac{1}{2} vmax$

ال Km جدا صغيرة مقارنة بال S لدرجة بهملها (بس بحالة الجمع).

$S \gg Km$ (Substrate) لمّا يكون عندي تركيز عالي جدا من

$$Vo = \frac{Vmax[S]}{km+[S]} , \quad Vo = \frac{Vmax[S]}{[S]} , \quad \boxed{V_0 = Vmax}$$

$S \ll Km$. (Substrate) لمّا يكون عندي تركيز قليل جدا من

↳ قليلة جدا لدرجة يمكن أهملها.

$$Vo = \frac{Vmax[S]}{Km+[S]} , \quad Vo = \frac{Vmax}{Km}[S]$$

ما بهملها بالبسط لأنها حالة ضرب

بتذكّر عندي

$$Vo = \frac{Vmax}{Km} . [S]$$

Vo → محور ال y

[S] → محور ال x

$Y = a \, X + b$ ←

وهيك عرفنا من وين إجت ..

مش أخدنا أيام التوجيهي إنه المشتقة هي الميل

$Y = ax + b$

$\boxed{\acute{y} = a}$ → الميل = vmax / Km

نقطة التقاطع مع $\boxed{\text{محور } y}$

يعني لمّا $X = Zero$

$y = a \cdot Zero + b$

$\boxed{y = b}$ → لما تكون $x = 0$

Question 💡 if [S] = 2km , the Vo =

okay ,.. relax .. we know that , $V_0 = \frac{V_{max}[S]}{km + [S]}$, $V_0 = \frac{[V_{max}][2km]}{km + 2km} = \frac{V_{max}[2km]}{[3km]}$

Easy $= \frac{2}{3} V_{max}$

* another one ? okay .. if Km for Enzyme X = 0.1 mM , that will be the Vo when [S] = 5 mM ?

$V_0 = \frac{[V_{max}] . 5}{0.1 + 5} = V_{max}\ 0.98 \rightarrow 98\%$ of vmax ..

كيف بدي اتأكد من حلي منطقيا ؟؟ S > Km ← Vo في Vmax و yes كثير قريبة منه..

* Question $V_0 = 1/3\ V_{max}$, S = ??

$\frac{1}{3} V_{max} = \frac{V_{max}[S]}{S + Km}$, $\frac{1}{3} = \frac{[S]}{S + Km}$, $S + Km = 3[S]$

$Km = 2[S]$

if $\frac{S}{Km} > 1 \rightarrow S \gg Km \rightarrow$ (Vo) greater than 1/2 vmax

if $\frac{S}{Km} < 1 \rightarrow S \ll Km \rightarrow$ (Vo) Lower than 1/2 vmax

if $\frac{S}{Km} = 1 \rightarrow$ Vo ≈ ½ Vmax

مثل القانون اللي حكيناه باول صفحة

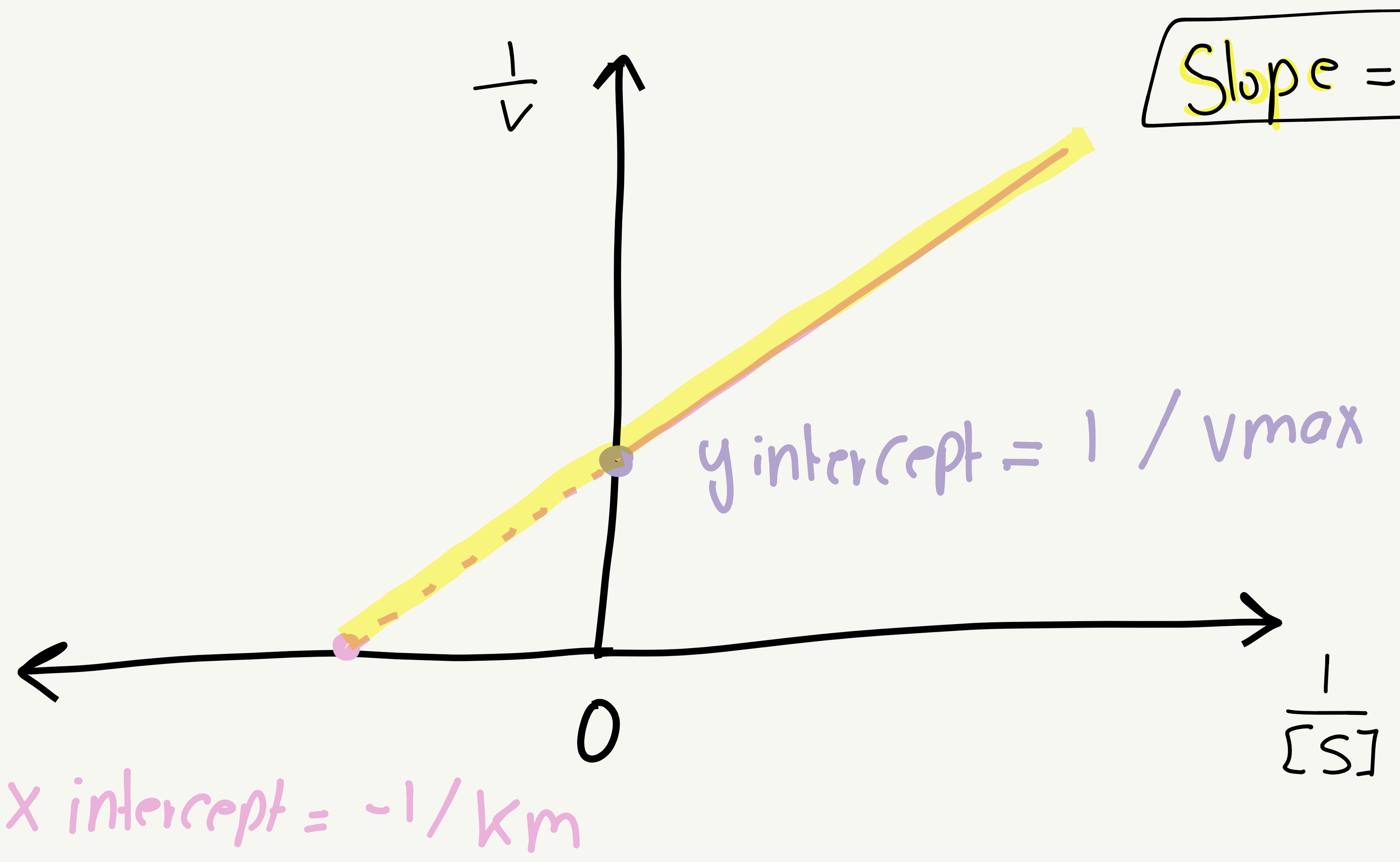
$\frac{S}{Km} = 1$, $Km = S \rightarrow V_0 = 1/2\ V_{max}$

Linearizing Michaelis-Menten Equation

* to determine Vmax and Km accurately

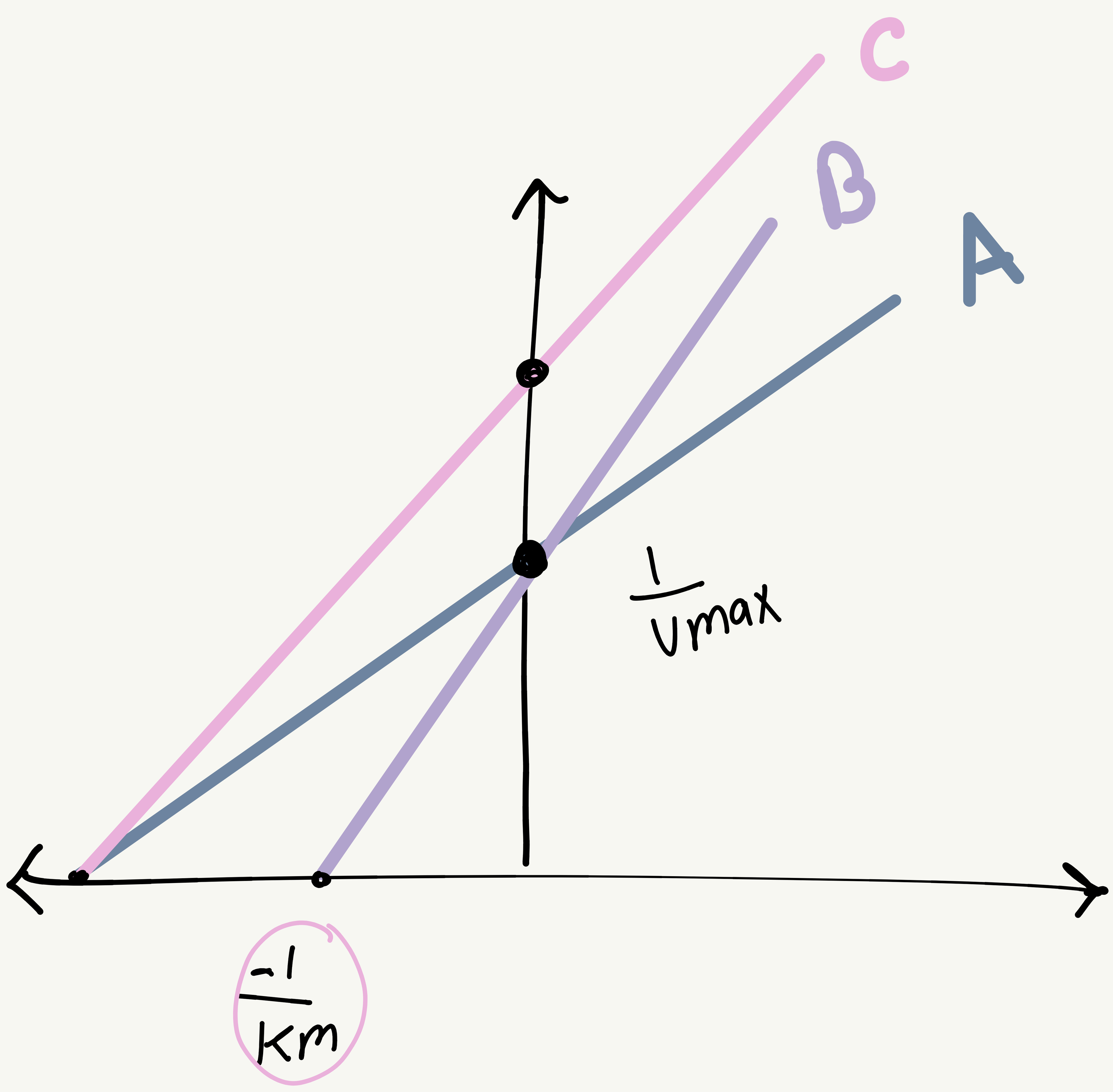
$$V_0 = \frac{V_{max}[S]}{K_m + [S]}$$ ناخذ مقلوب → $$\frac{1}{V_0} = \frac{K_m + [S]}{V_{max}[S]} , \quad \frac{1}{V_0} = \frac{K_m}{V_{max}[S]} + \frac{1}{V_{max}}$$

$y = ax + b$



Slope = Km / Vmax

Slope ال عكس
Low Substrate conc. (Michaelis-Menten).



Slope A < slope B
Km A < Km b
* لما تكون ال Vmax متساوية

Slope C > Slope A
Vmax c < Vmax A
* لما تكون ال Km متساوية.

Done by Sala dwaikat ..

Artery Academy .. ♥♥