$$\boldsymbol{\psi}(\boldsymbol{x},\boldsymbol{t}) = \boldsymbol{u}(\boldsymbol{x})\emptyset(\boldsymbol{t})e^{ikx}e^{-\frac{E}{\hbar}t}$$

$$\frac{d^2\boldsymbol{\psi}(\boldsymbol{x})}{dx^2} + \frac{2m}{\hbar^2}[\,E - V(x)]\boldsymbol{\psi}(\boldsymbol{x}) = 0 - --\rightarrow 1$$

$$\frac{d^2\boldsymbol{\psi}(\boldsymbol{x})}{dx^2} + \frac{2m}{\hbar^2}[\,E]\boldsymbol{\psi}(\boldsymbol{x}) = 0 - --\rightarrow 2 \quad at \quad 0 < x < a \quad V(x) = 0 \quad Region\ I$$

$$\frac{d^2\boldsymbol{\psi}(\boldsymbol{x})}{dx^2} + \frac{2m}{\hbar^2}[\,E - V_o]\boldsymbol{\psi}(\boldsymbol{x}) = 0 - --\rightarrow 3 \;\; at \quad -b < x < 0 \quad V(x) = V_o \quad Region\ II$$

Put : $\alpha^2 = \frac{2mE}{\hbar^2} - --\rightarrow \alpha = \sqrt{\frac{8\pi^2 m}{h^2}} - --\rightarrow \alpha = \frac{\sqrt{2mE}}{\hbar}$

$$\beta^2 = \frac{2m}{\hbar^2}[V_o - E]$$

So equation 2 and 3 become

$$\frac{d^2\boldsymbol{\psi}(\boldsymbol{x})}{dx^2} + \alpha^2[\,E]\boldsymbol{\psi}(\boldsymbol{x}) = 0 - --\rightarrow 4 \; at \quad 0 < x < a \quad V(x) = 0 \quad Region\ I$$

$$\frac{d^2\boldsymbol{\psi}(\boldsymbol{x})}{dx^2} - \beta^2\boldsymbol{\psi}(\boldsymbol{x}) = 0 - --\rightarrow 5 \; at \quad 0 < x < a \quad V(x) = V_o \quad Region\ I$$

$$\boldsymbol{\psi}(\boldsymbol{x}) = \boldsymbol{U}(\boldsymbol{x})\boldsymbol{e}^{\boldsymbol{ikx}}$$

This traveling-wave solution represents the motion of an electron in a single-crystal material. The amplitude of the traveling wave is a periodic function and the parame***ter*** k is also referred to as a wave number.

We solved all the equation in two region and find

$$\frac{\beta^2 + \alpha^2}{2\alpha\beta}\sin(\alpha a)\sinh(\beta b) + \cos(\alpha a)\cosh(\beta b) = cosk(a + b) - --\rightarrow 12$$

V_o b : barrier height (Strength)

If $V_o - -\rightarrow \infty \quad that\ means\ b -\rightarrow 0 \quad so \quad \sinh(\beta b) = \beta b \;,\; \cosh(\beta b) = 1$

Equation 12 become

$$\frac{(\beta^2 + \alpha^2)\;\beta b}{2\alpha\beta}\sin(\alpha a) + \cos(\alpha a) = coska - --\rightarrow 13$$

$$\beta^2 + \alpha^2 = \frac{2m}{\hbar^2}[V_o - E] + \frac{2m}{\hbar^2}E = \frac{2m}{\hbar^2}V_o - --\rightarrow 14$$

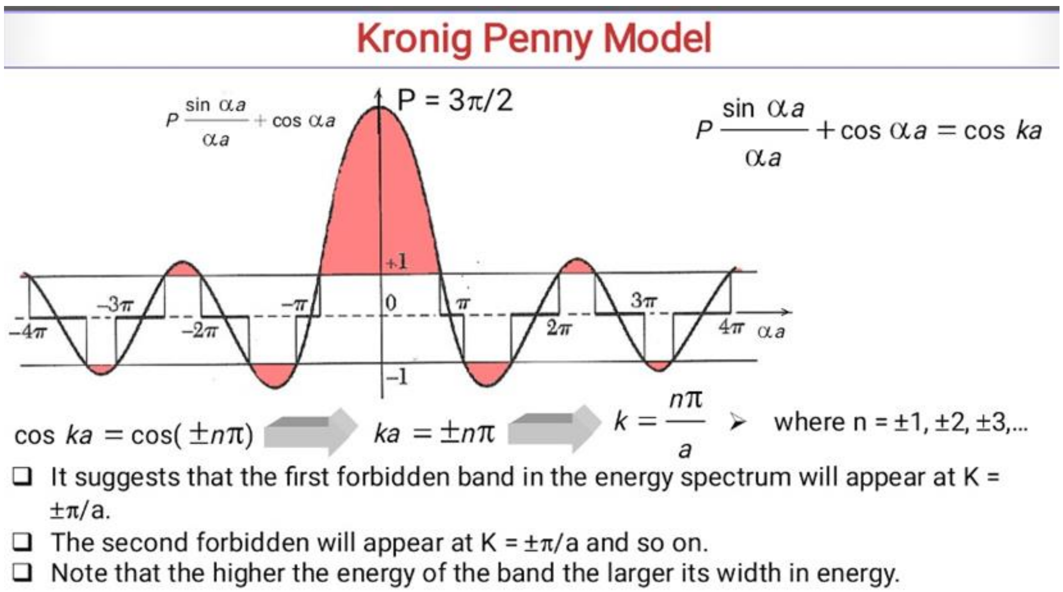
Substitute eq 14 in 13 we get

$$\frac{mV_o\;\alpha b}{\hbar^2}\frac{\sin(\alpha a)}{\alpha a} + \cos(\alpha a) = coska - -\rightarrow 15$$

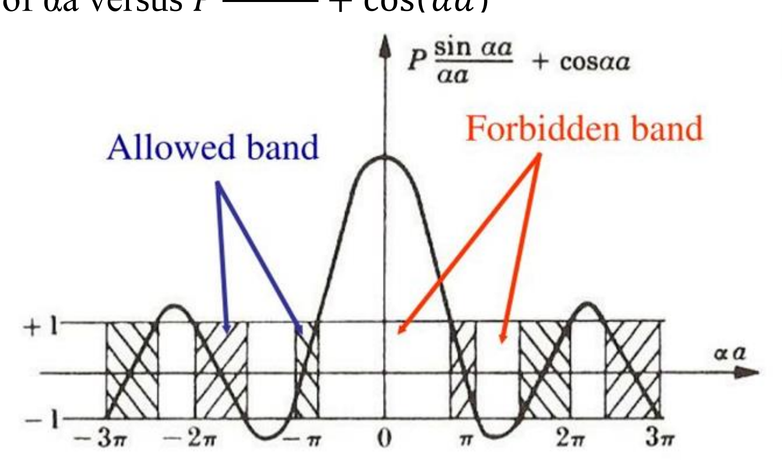
$$P\frac{\sin(\alpha a)}{\alpha a}+\cos(\alpha a)=coska ----\rightarrow 16$$

Where P is scattering power and $P=\frac{mV_o\,\alpha b}{\hbar^2}$

The equation 16 is analysis by drawing graph between $P\frac{\sin(\alpha a)}{\alpha a}+\cos(\alpha a)$ versus αa see Fig (1, 2, 3)



Fig(1): A plot of αa versus $P\frac{\sin(\alpha a)}{\alpha a}+\cos(\alpha a)$



Fig(2): A plot showed allowed band and forbidden band

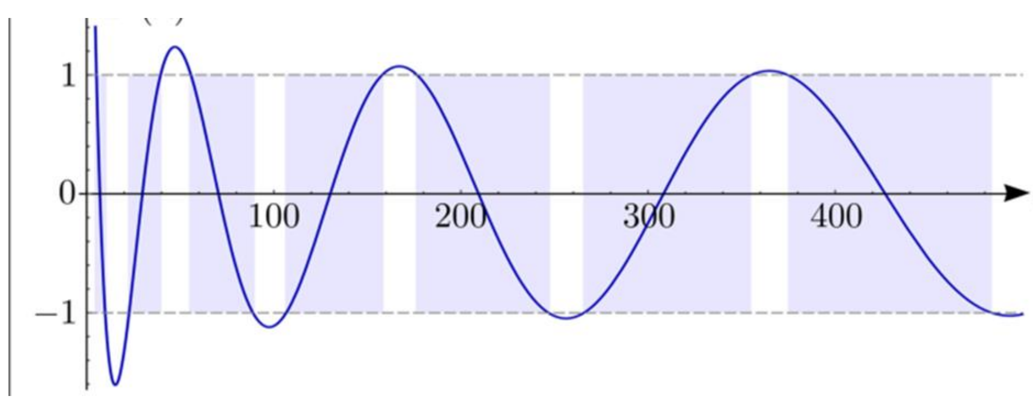


Fig (3) : A plot shows that as increasing αa increases allowed band