$$\ln \tau(s) = -47.6 - 74.5 + \ln\sqrt{\frac{1}{E}} + 341\sqrt{\frac{1}{E}}$$

$$\ln \tau(s) = -122 + \ln\sqrt{\frac{1}{E}} + 341\cdot\sqrt{\frac{1}{E}}$$

E in MeV

① E = 1 MeV

$$\ln \tau(s) = -122 + 341 = 218$$

$$\log_{10}\tau = \log_{10}e \cdot \ln\tau$$
$$= 0{,}434 \ln\tau = 95$$

$$\tau = 10^{95}\ s \simeq \frac{10^{95}}{3.14\cdot 10^{7}} = 3\cdot 10^{87}\ y!$$

② E = 5 MeV

$$\log_{10}\tau(s) = 12.8 \Rightarrow \underline{\underline{1.9\cdot 10^{5}\ y}}\ !$$

Check:

$$\ln\tau = \underbrace{\ln\left[2.1\cdot 10^{-21} s\sqrt{\frac{1}{E}}\right] - 74.5}\ + \underbrace{341\sqrt{\frac{1}{E}}}$$

$E=1$	$= -122.1$	340.6
$E=5$	$= -122.9$	152.3

$$\ln\tau \simeq -122.5 + 341\cdot\sqrt{\frac{1}{E}}$$

$$\log_{10}\tau \simeq -53 + 148\cdot\sqrt{\frac{1}{E}}$$

(see plot)

Quantization as an Eigenvalue Problem

Simplest application... particle in a (1-d) box...

Schrödinger Equation... (1-d)

$$\underbrace{\frac{-\hbar^2}{2m}\frac{d^2}{dx^2}\Psi(x,t) + V(x)\Psi(x,t)} = i\hbar\frac{\partial}{\partial t}\Psi(x,t)$$

Total Energy:

Kinetic $\rightarrow \frac{-\hbar^2}{2m}\frac{d^2}{dx^2}$

Potential $\rightarrow V(x)$.

"Eigenvalue"

$$\frac{-\hbar^2}{2m}\frac{d^2}{dx^2}\Psi(x,t) + V(x)\Psi(x,t) = E\Psi(x,t) = i\hbar\frac{\partial}{\partial t}\Psi(x,t)$$

just a multiple!

Time dependence super easy:

in this case, $\Psi(x,t) = \varphi(x)e^{\frac{-iE}{\hbar}t}$

$$i\hbar\frac{\partial\Psi}{\partial t} = \Psi(x)\cdot\left(\cancel{i\hbar}\frac{-iE}{\cancel{\hbar}}\right)e^{\frac{-iEt}{\hbar}}$$

$$= E\,\Psi(x)\,e^{\frac{-iEt}{\hbar}} = E\Psi(x,t)$$

but $\psi(0) = \psi(a) = 0$

$$Ae^{+0} + Be^{-0} = 0 \qquad A\left(e^{ika} - e^{-ika}\right) = 0$$

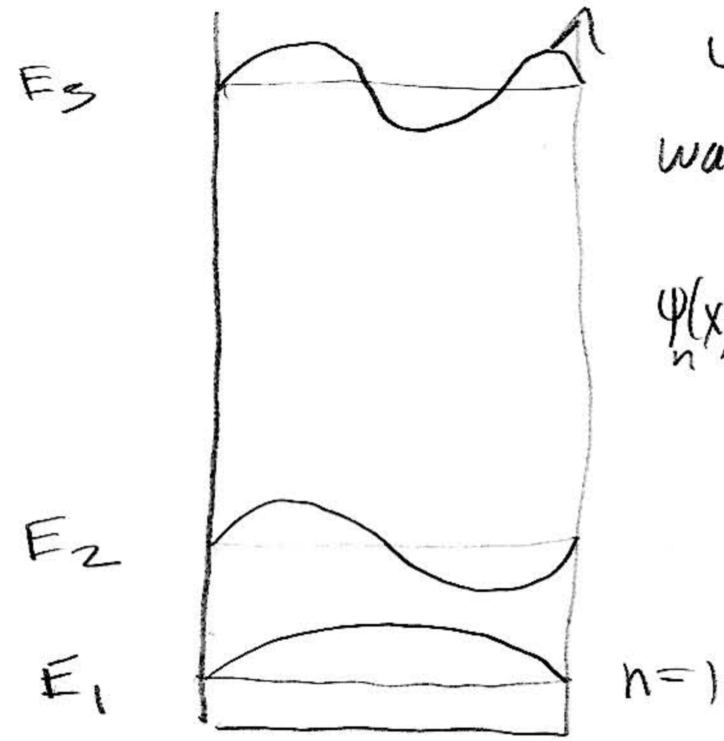
$$B = -A \qquad 2Ai\sin(ka) = 0$$

$$ka = n\pi \;!$$

$$E_n = \frac{\hbar^2}{2m}\left(\frac{n\pi}{a}\right)^2$$

$$= n^2 \underbrace{\frac{\hbar^2\pi^2}{2ma^2}}_{E_1}$$

$$\boxed{E_n = n^2 E_1}$$



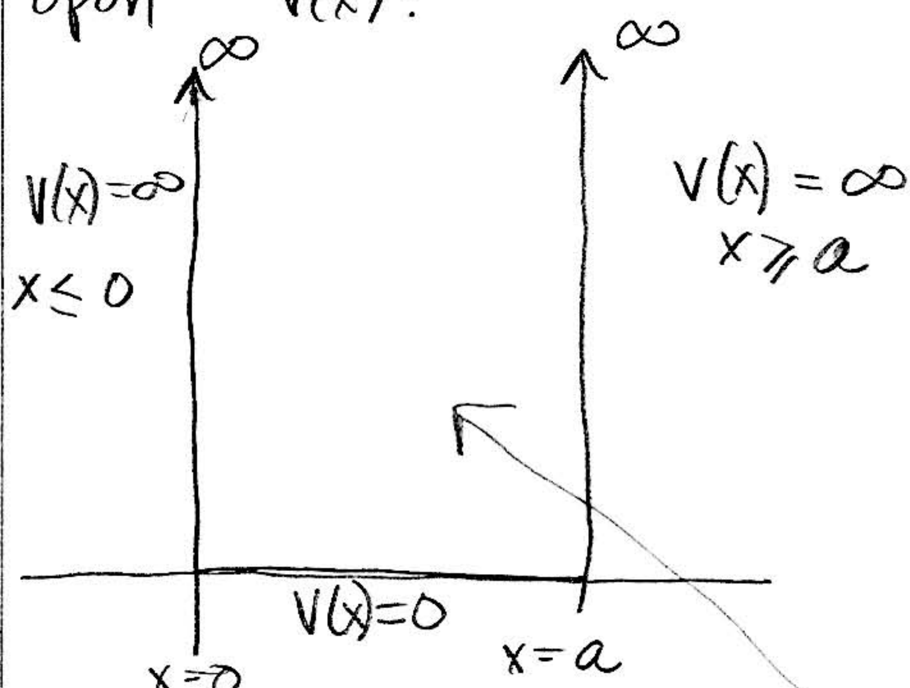
$\psi(x,t)_a$

want $\int_0^a dx\, |\psi(x,t)|^2 = 1$

$$\psi_n(x,t) = \sqrt{\frac{2}{a}}\sin\left(\frac{n\pi x}{a}\right)e^{\frac{-iE_n t}{\hbar}}$$

$$\frac{-\hbar^2}{2m}\frac{d^2}{dx^2}\Psi(x) + V(x)\,\Psi(x) = E\,\Psi(x)$$

needs to be solved, all in space, for the time dependence to be appropriate. In general, this will depend upon $V(x)$:



here, $V(x)=0$.

$$\frac{-\hbar^2}{2m}\frac{d^2}{dx^2}\Psi(x) = E\,\Psi(x)$$

$$\Psi(x) = Ae^{\pm ikx}$$

then $\dfrac{-\hbar^2(\pm ik)^2}{2m} Ae^{\pm ikx} = E\,Ae^{\pm ikx}$

$\left(\dfrac{p^2}{2m}\right)$ $\qquad \dfrac{\hbar^2 k^2}{2m} = E \;\rightarrow\; k = \sqrt{\dfrac{2m}{\hbar^2}E}$