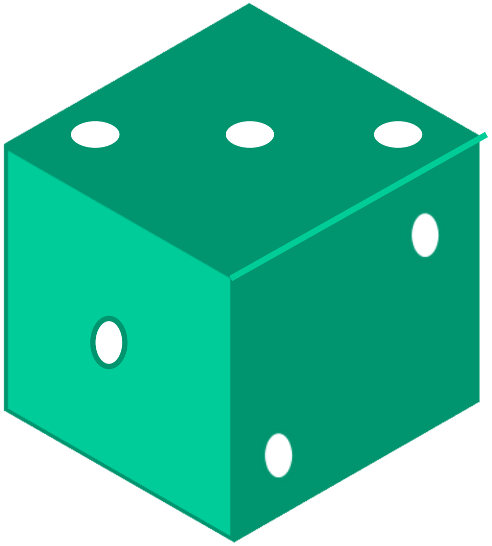
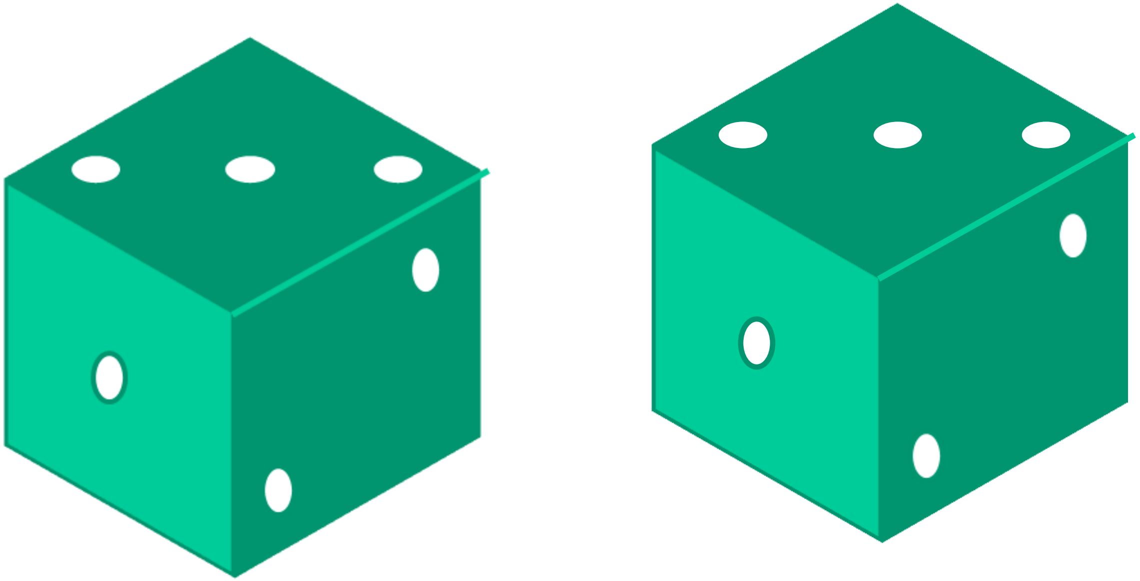


What are the eigen values for the die ?

Calculate the expectation value.



What are the eigen values for the dice ?
Calculate the expectation value.

Schrödinger Equation

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

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

$$\Psi(x,t) = \psi(x)f(t)$$

$$i\hbar\psi(x)\frac{\partial f(t)}{\partial t} = -\frac{\hbar^2}{2m}f(t)\frac{\partial^2\psi(x)}{\partial x^2}+V(x)\psi(x)f(t)$$

$$i\hbar\frac{1}{f(t)}\frac{\partial f(t)}{\partial t} = -\frac{\hbar^2}{2m}\frac{1}{\psi(x)}\frac{\partial^2\psi(x)}{\partial x^2}+V(x) = E$$

$$i\hbar\frac{1}{f(t)}\frac{\partial f(t)}{\partial t} = E$$

$$\frac{1}{f(t)}\frac{\partial f(t)}{\partial t} = \frac{-iE}{\hbar}$$

$$\frac{\partial f(t)}{f(t)} = \frac{-iE}{\hbar}\partial t$$

$$\boxed{f(t) = f_0 \exp(\frac{-iE}{\hbar}t)}$$

Time independent Schrödinger eqn.

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi(x)}{\partial x^2} + V(x)\psi(x) = E\psi(x)$$

$$\frac{d^2\psi(x)}{dx^2} + \frac{2m}{\hbar^2}(E - V(x))\psi(x) = 0$$

Particle in a box of size L

$$\psi(x) = A\cos(kx) + B\sin(kx)$$

$$\psi(x) = 0, \qquad x = 0, L$$

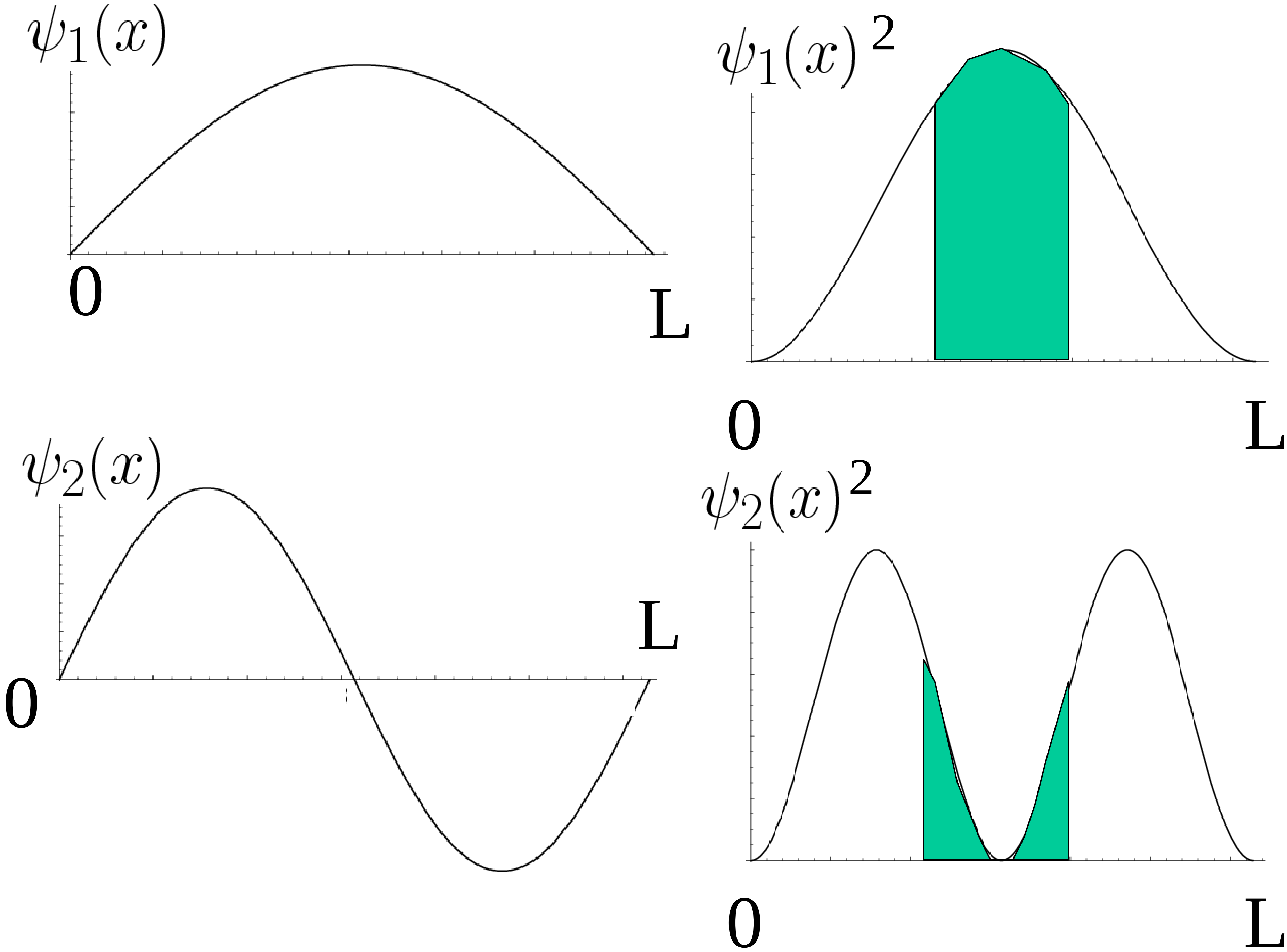
$$\psi_n(x) = B\sin(\frac{n\pi}{L}x), \qquad n = 1, 2, 3, \cdots$$

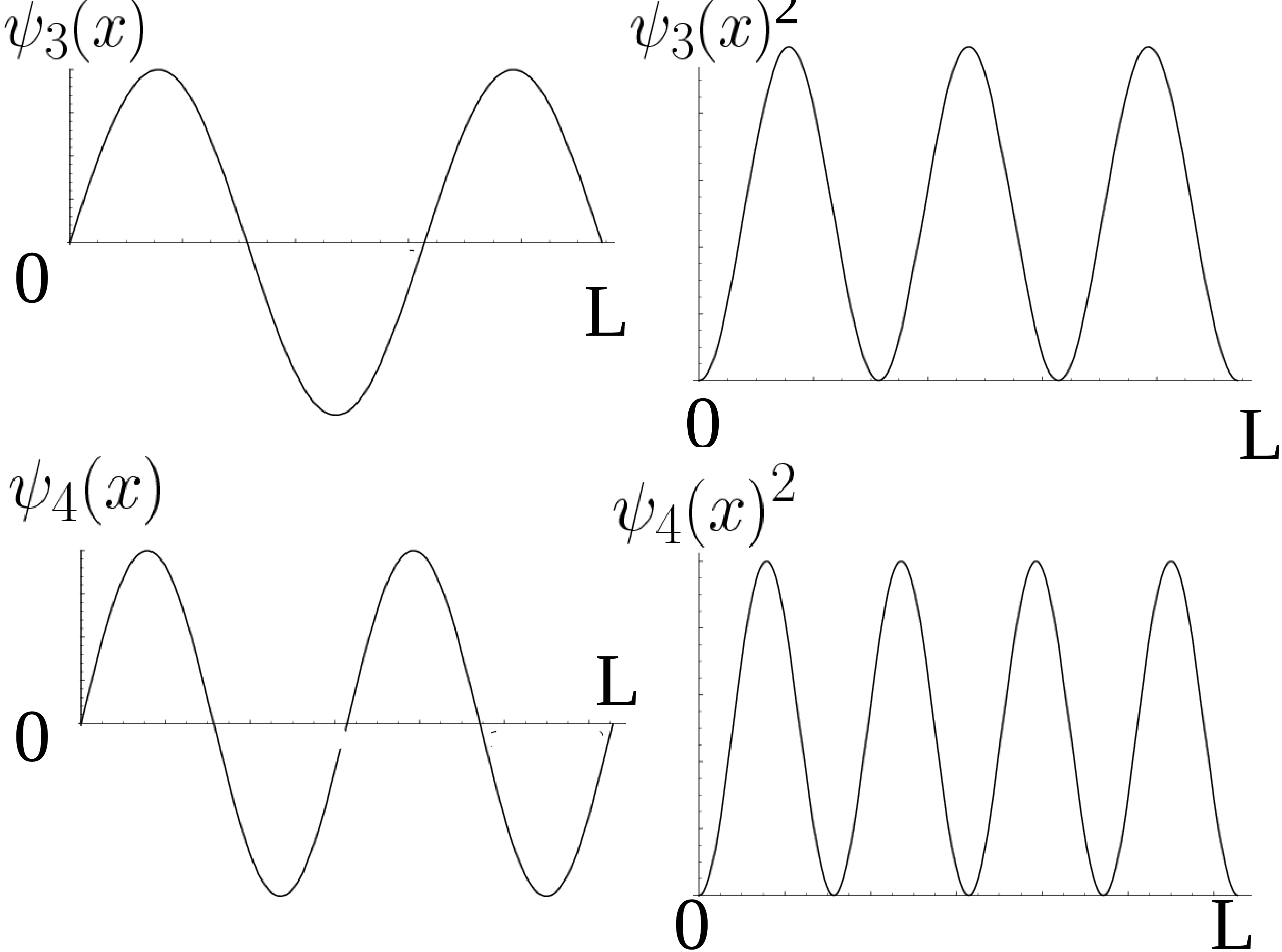
$$E_n = p^2/2m = n^2\hbar^2\pi^2/2mL^2$$

$$\int_{-\infty}^{\infty} \psi_n^*(x)\psi_m(x)dx = 0$$

$$\int_{-\infty}^{\infty} \psi_n^*(x)\psi_n(x)dx = 1$$

$$B = \sqrt{\frac{2}{L}}$$


$\psi_1(x)$
0
L
$\psi_1(x)^2$
0
L
$\psi_2(x)$
L
0
$\psi_2(x)^2$
0
L



$\psi_3(x)$
0
L
$\psi_3(x)^2$
0
L
$\psi_4(x)$
L
0
$\psi_4(x)^2$
0
L

Find the probability that a particle trapped in one dimensional box of length L can be found between 0.45L and 0.55L for the ground state .

$$P = \int_{0.45L}^{0.55L} \psi_1^*(x)\psi_1(x)dx$$

$$P = \frac{2}{L}\int_{0.45L}^{0.55L} \sin^2(\pi x/L)dx$$

$$P = \frac{1}{L} \int_{0.45L}^{0.55L} (1 - \cos(2\pi x/L))dx$$

$$P = \frac{1}{L} \left[x - \frac{L}{2\pi} \sin(2\pi x/L) \right]_{0.45L}^{0.55L}$$

$$P = \frac{1}{L} \left[0.1L - \frac{L}{2\pi} (\sin(1.1\pi) - \sin(0.9\pi)) \right]$$

$$P = 0.198$$

Electron trapped inside the atom

$L = 10^{-10}$ m

Ground state energy

$$E_1 = (10^{-34})^2 \times 10/(2 \times 10^{-30} \times (10^{-10})^2)$$

$$E_1 \simeq (0.5 \times 10^{-67})/10^{-50}$$

$$E_1 \simeq 0.5 \times 10^{-17} \text{ J}$$

$$E_1 \simeq 0.5 \times 10^{-17}/(1.6 \times 10^{-19}) \simeq 30eV$$

α-particle inside the nucleus

Ground state energy

L=2x10^{-15} m

$$E_1 = (10^{-34})^2 \times 10/2 \times 6.4 \times 10^{-27} \times (2 \times 10^{-15})^2$$

$$E_1 \simeq 10^{-10}/50 \text{ J} \simeq 10 \text{ MeV}$$