1. (a) Write down for the following 1-dimensional potential functions $V(x)$ the stationary Schrödinger equation for the corresponding wave functions $\psi_n(x)$ of a particle of mass m. Simplify this using $m = 1$ and $\hbar = 1$.

   (b) Sketch the potential together with the corresponding wave functions $\psi_n(x)$ of the ground states and of the first two excited states.

   (c) What can be said about the parity (symmetry) and the number of the nodes of the wave functions? How do these depend on the symmetry of the potential?

   (d) What are the expectation values for coordinate x and momentum p_x of a particle in the three sketched states? (without calculation)

   (e) Use for the discussions above the following potentials:

	$V(x)$	$\psi(x)$			
1)	$2\ x^2$	e^{-x^2}	$x\ e^{-x^2}$	$(1-2\ x^2)\ e^{-x^2}$	$(1-4\ x^2)\ e^{-x^2}$
2)	$\frac{9}{2}(x-1)^2$	$e^{-\frac{3}{2}(x-1)^2}$	$(x-1)\ e^{-\frac{3}{2}(x-1)^2}$	$(1-6\ (x-1)^2)\ e^{-\frac{3}{2}(x-1)^2}$	
3)	$\frac{1}{\cos^2(x)}$	$\cos^2(x)$	$\sin(x)\cos^2(x)$	$\sin^2(x)\cos^2(x)$	

   and check which of the accompanying functions, are solutions of the corresponding stationary Schrödinger equation. ($m = 1$ and $\hbar = 1$)

   (f) For the eigen functions found above, give the energy values and the time dependence of the complete wave function $\Psi(x,t)$!

The results for (e) and (f) (X means no eigen function and therefore no energy eigen value):

V_1 :	1	3	X	5
V_2 :	$\frac{3}{2}$	$\frac{9}{2}$	$\frac{15}{2}$	
V_3 :	2	$\frac{9}{2}$	X	

$$\Psi_n(x,t) = \psi_n(x)\ e^{-i\frac{E_n}{\hbar}\ t} = \psi_n(x)\ e^{-i\ E_n\ t} \quad (\hbar = 1)$$