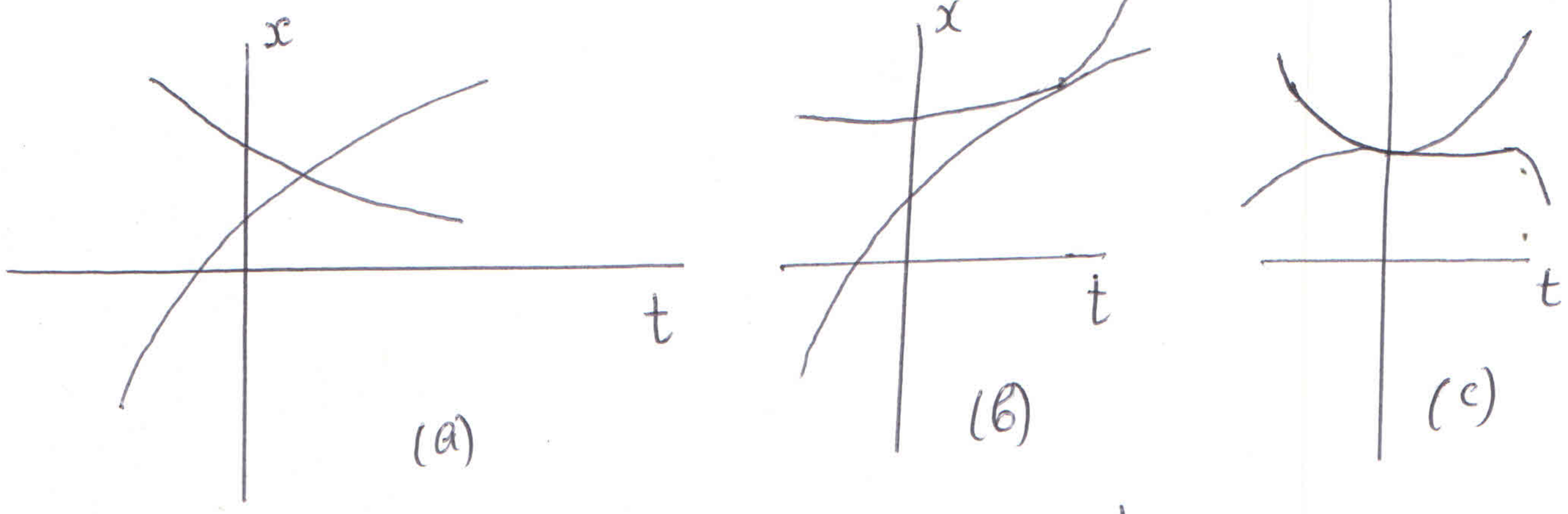


fig. 4.1. Two solutions of equation
$x'' = f(x) \in C^1(\mathbb{R})$ showed in fig. (a)
are possible, in fig. (b) and fig (c) - impossible.

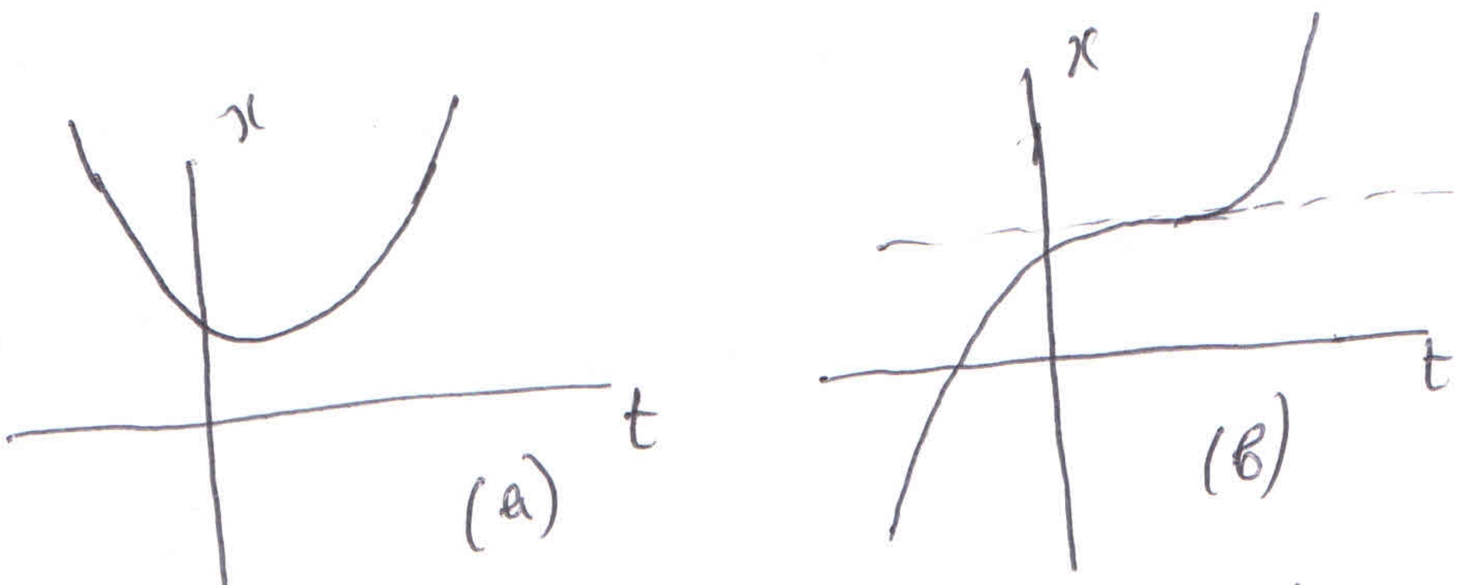


fig. 4.2. Solution of equation
$x'' = f(x) \in C^1(\mathbb{R})$ showed in fig. (a)
is possible, in fig. (b) - impossible.

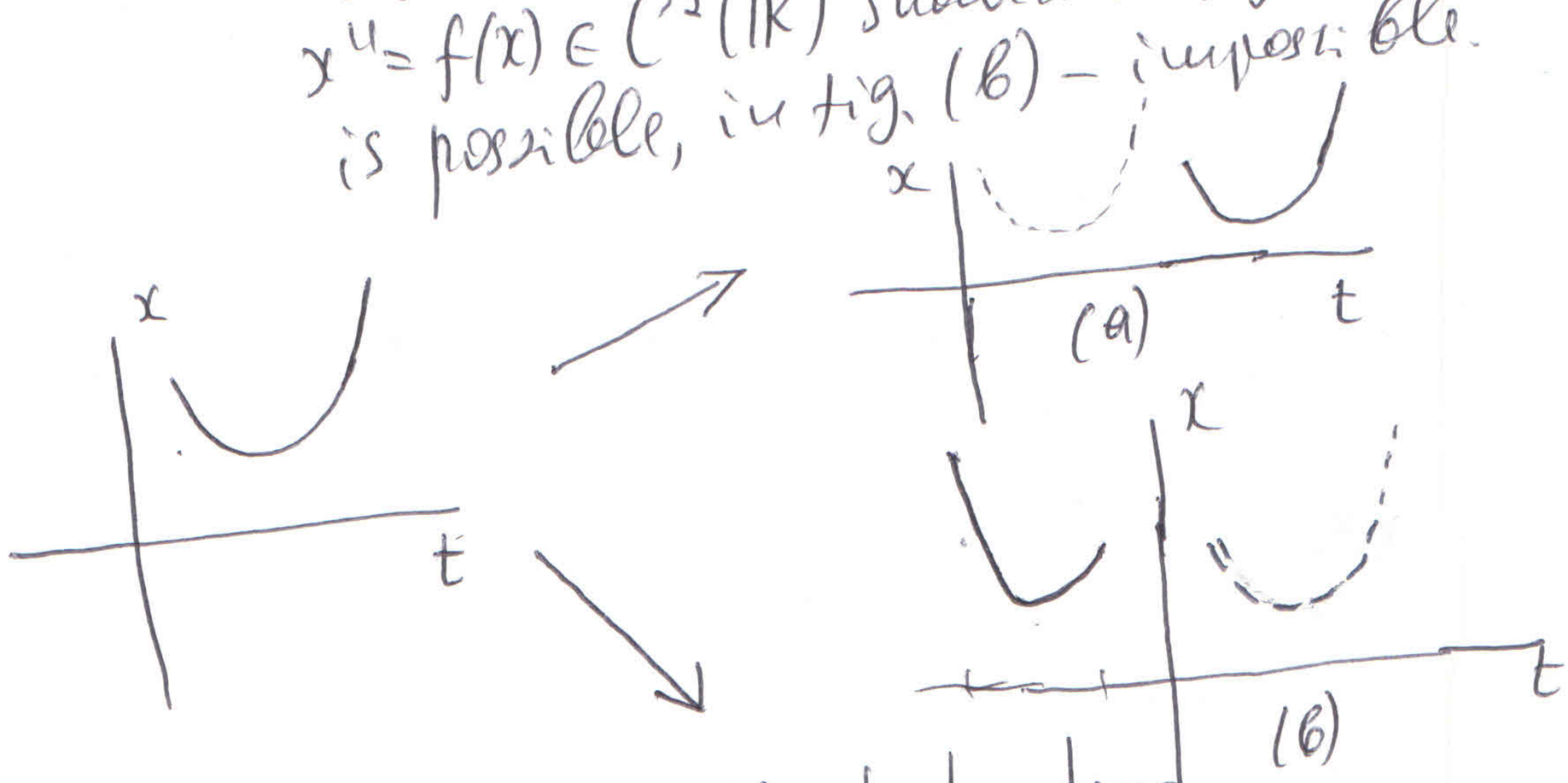


fig. 4.3. (a): shift of time
(b): inverse of time

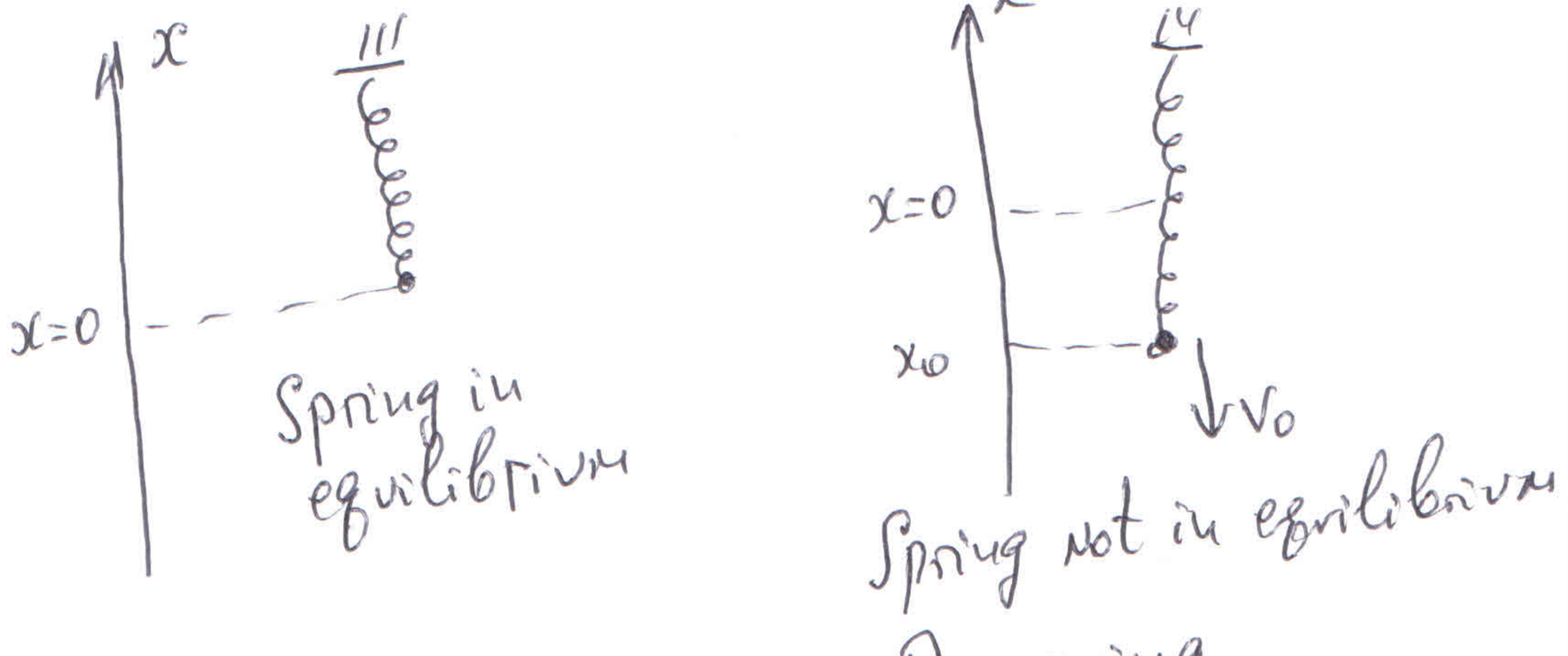


fig. 4.4. The spring

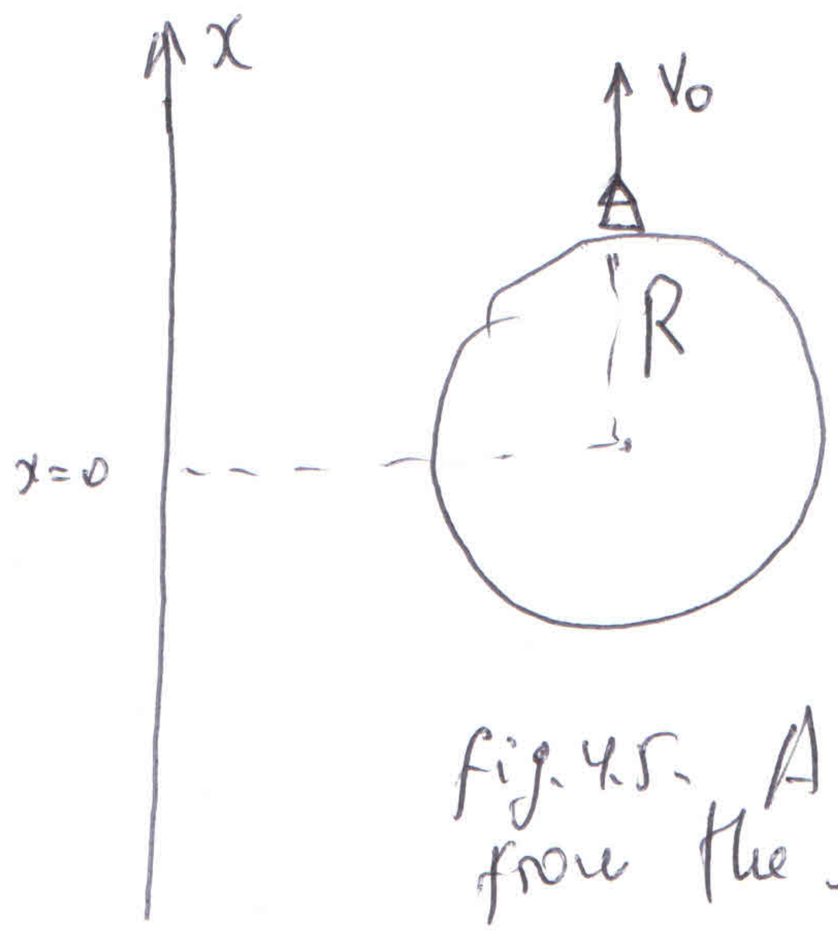


fig. 4.5. A rocket launched up from the surface of the Earth

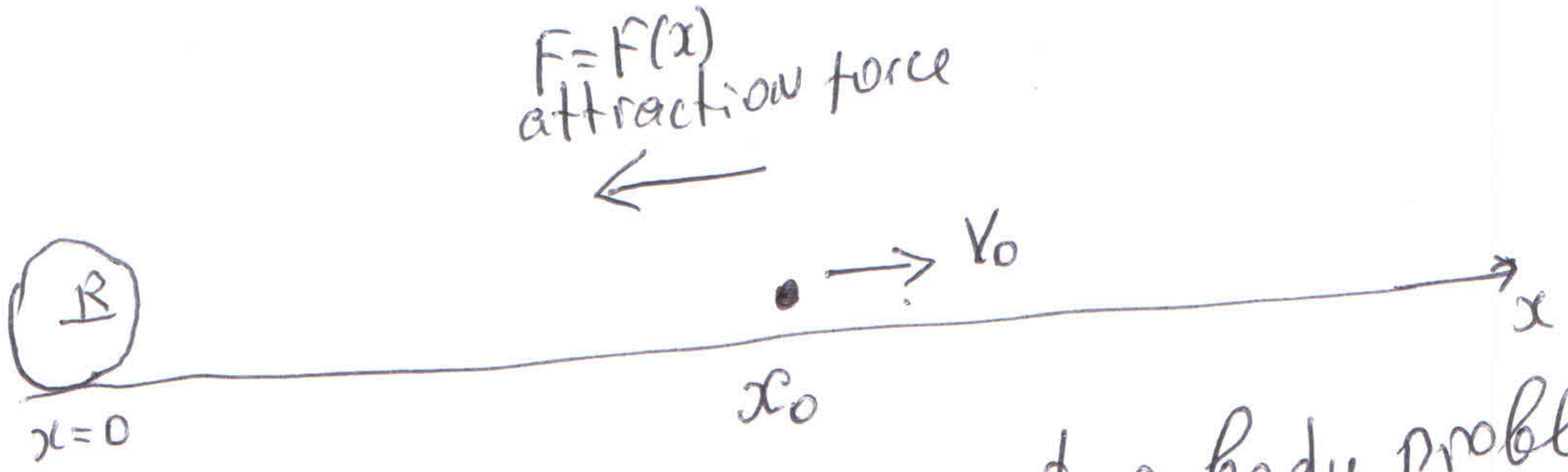
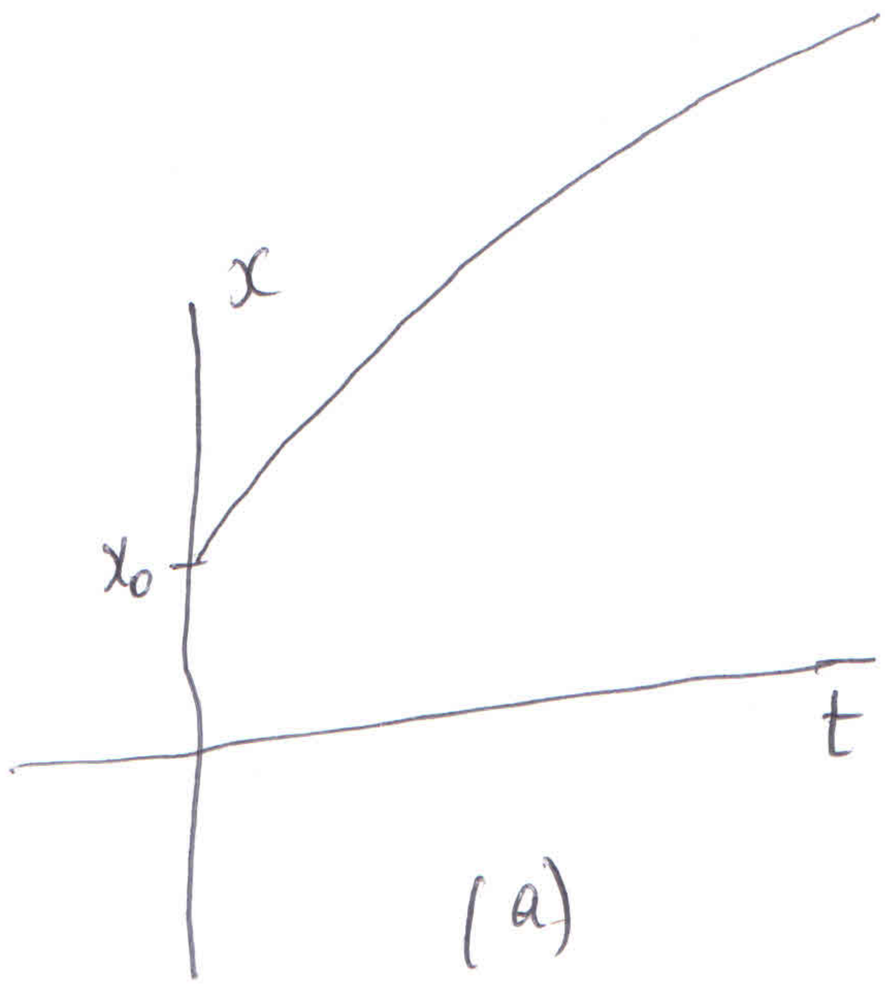
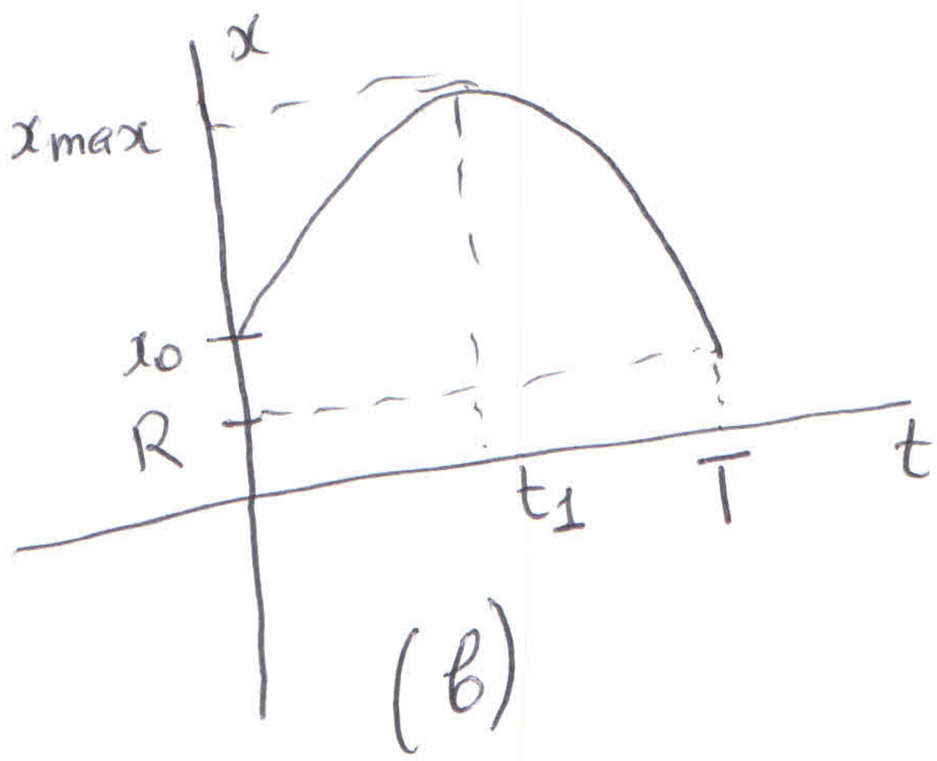


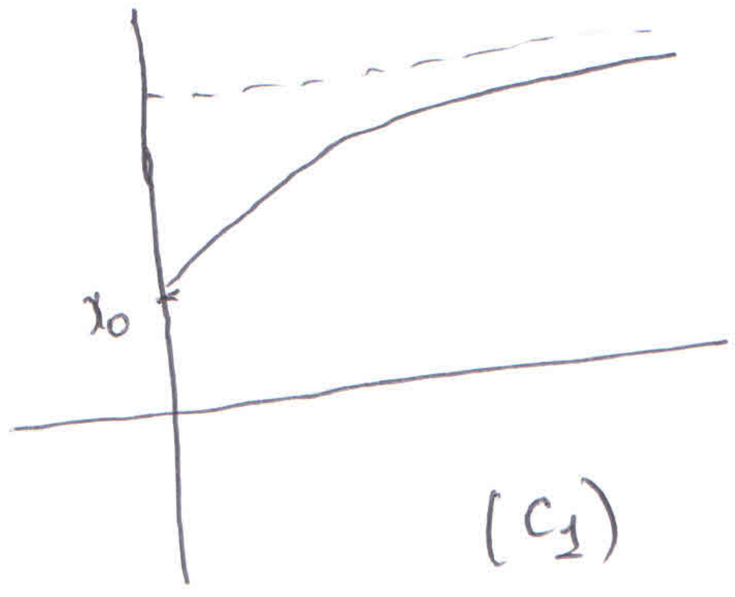
fig. 4.6 One of two body problems.



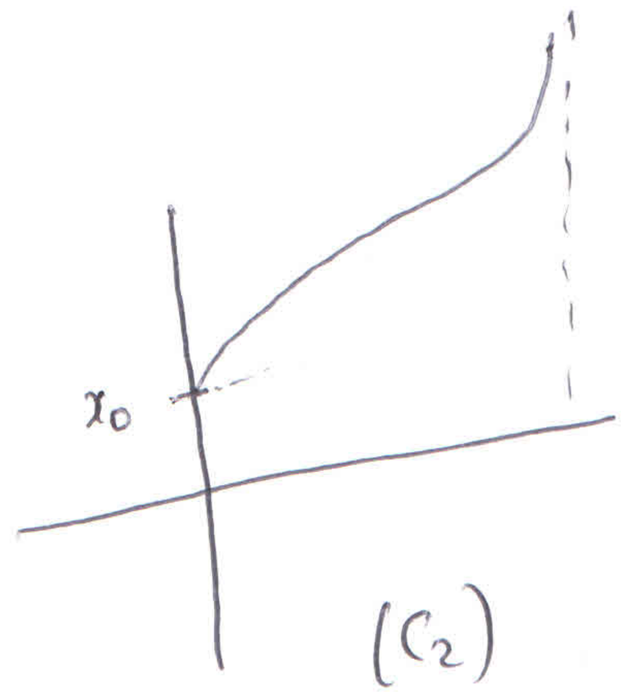
(a)



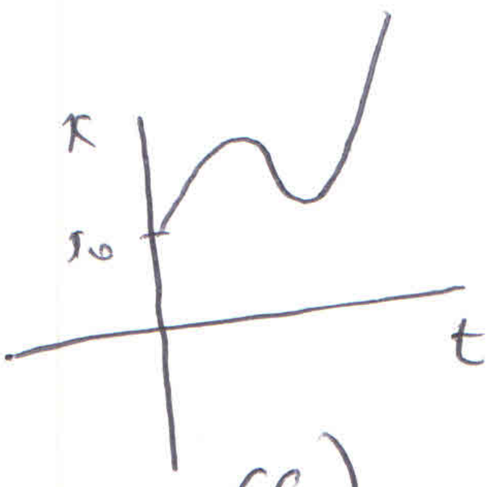
(b)



(c_1)

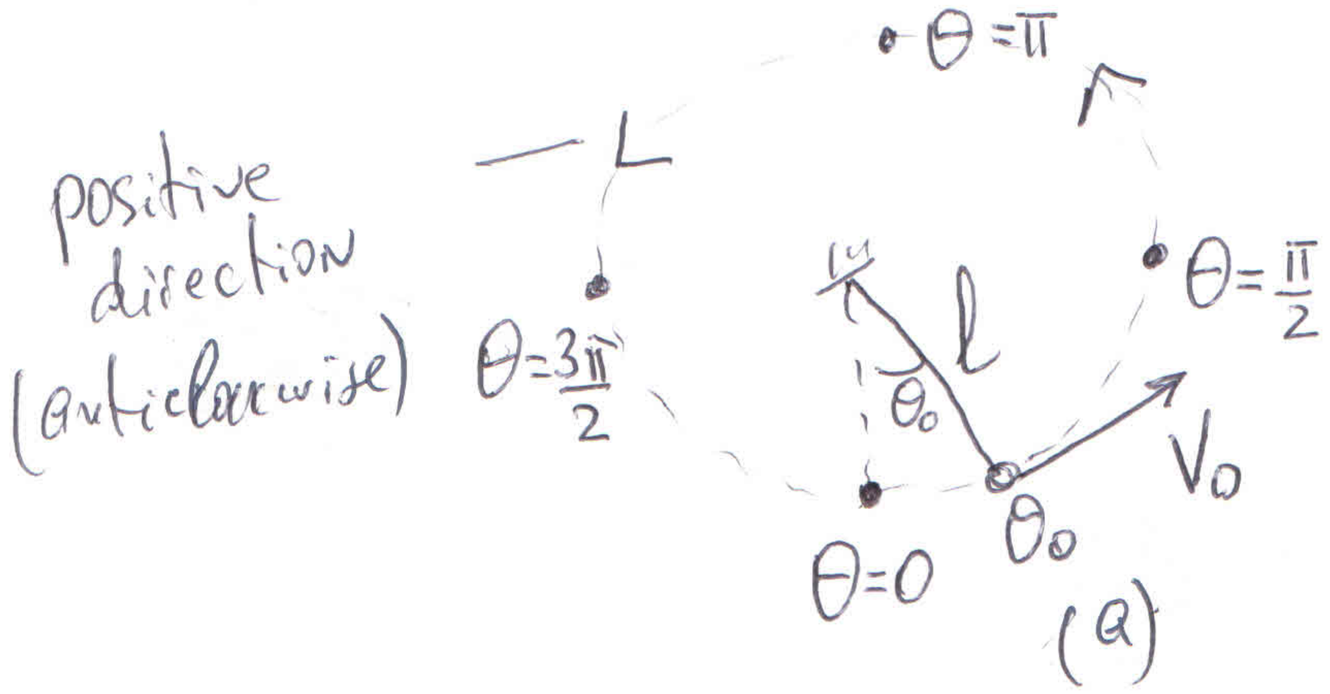


(c_2)

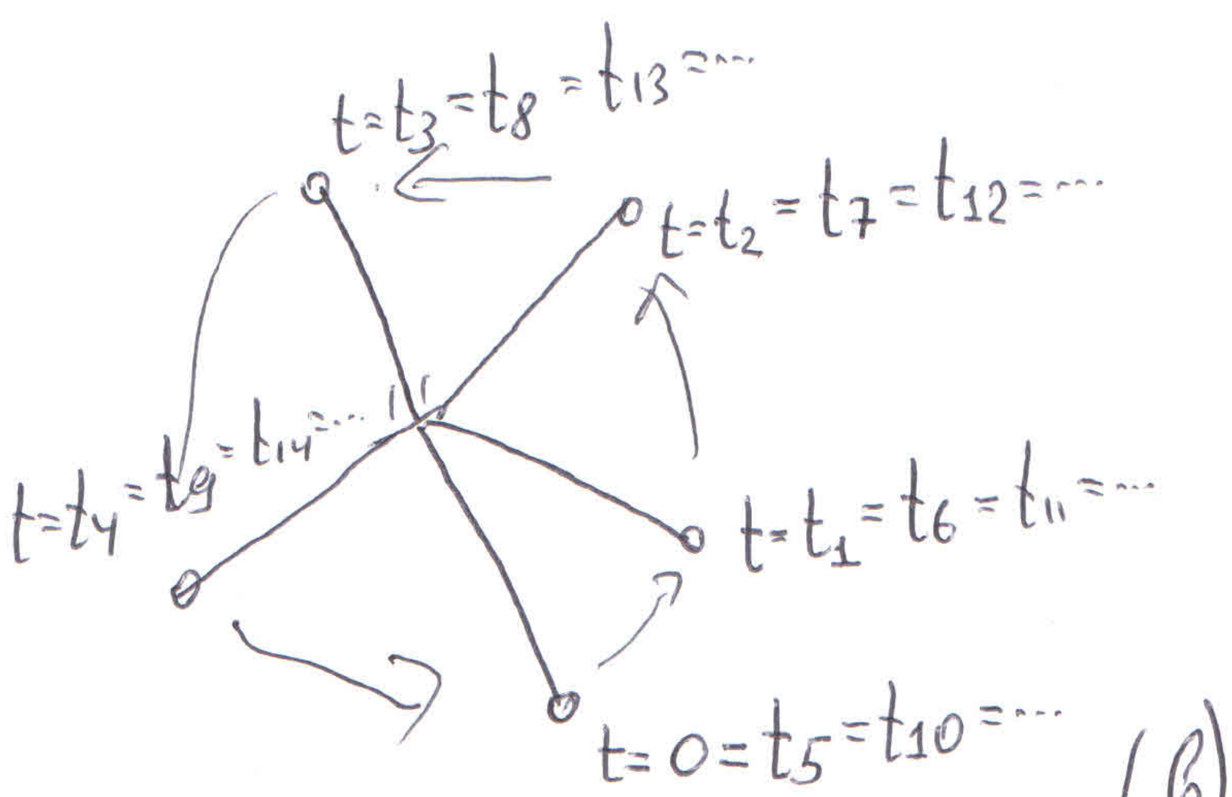


(c_3)

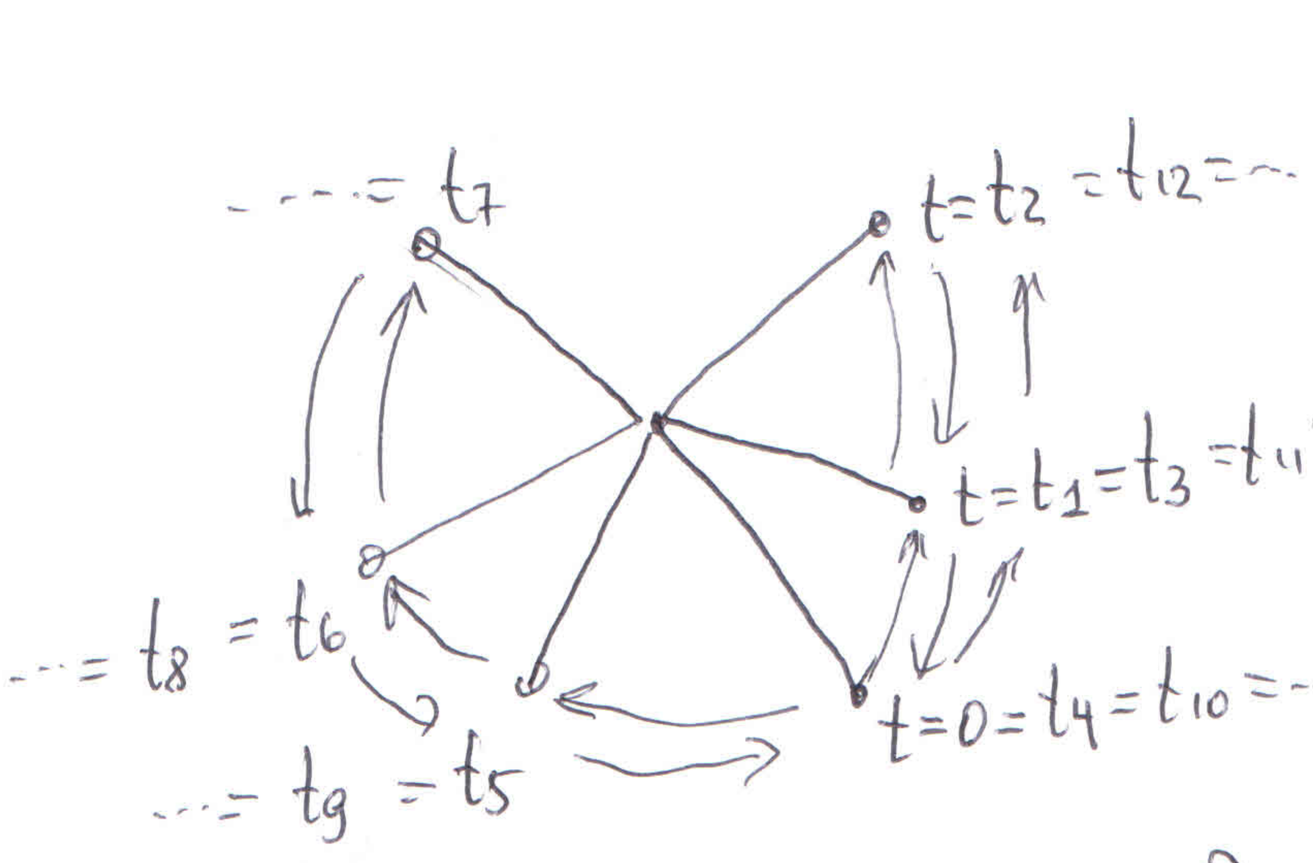
fig. 4.7. Solution of the two body problem: either (a) or (b); (c_1), (c_2), (c_3): impossible



θ : in rad
defined
mod $2k\pi$, $k\in\mathbb{Z}$!!



Pendulum turns over.
Position of the pendulum at time moments
$t=0<t_1<t_2<t_3<\cdots$
It is so $\Leftrightarrow$ $V_0>V_{0,crit}$



Pendulum oscillates.
Position of the pendulum at time-moments
$t=0<t_1<t_2<t_3<\cdots$
It is so $\Leftrightarrow$ $V_0<V_{0,crit}$

fig. 4.8. Pendulum or swing.
(a) :: All possible positions: circle S^1, with coordinate θ in rad; $\theta=0$: stable equilibrium, $\theta=\pi$: unstable equilibrium
(b) :: the case that the pendulum turns over
(c) :: the case that the pendulum oscillates.

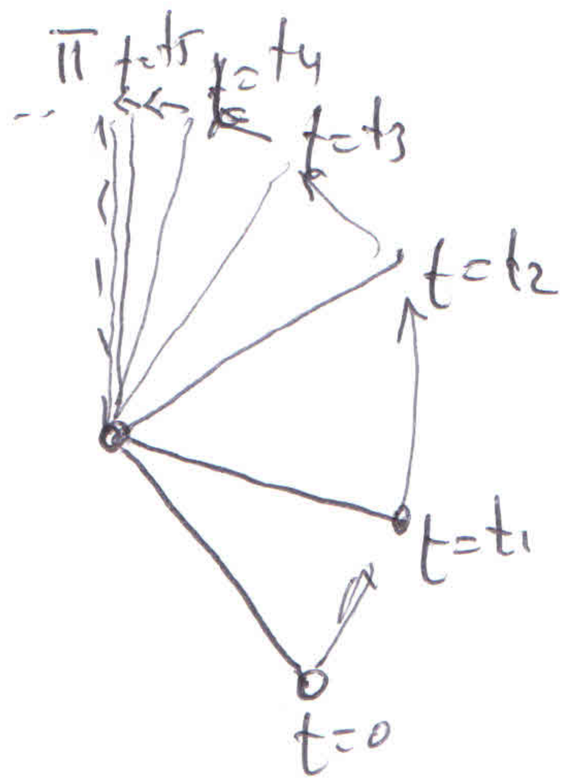


fig. 4.9. If $V_0 = V_{0,crit}$ the pendulum will approach $\theta = \pi$ (position of unstable equilibrium), but will never be in this position.

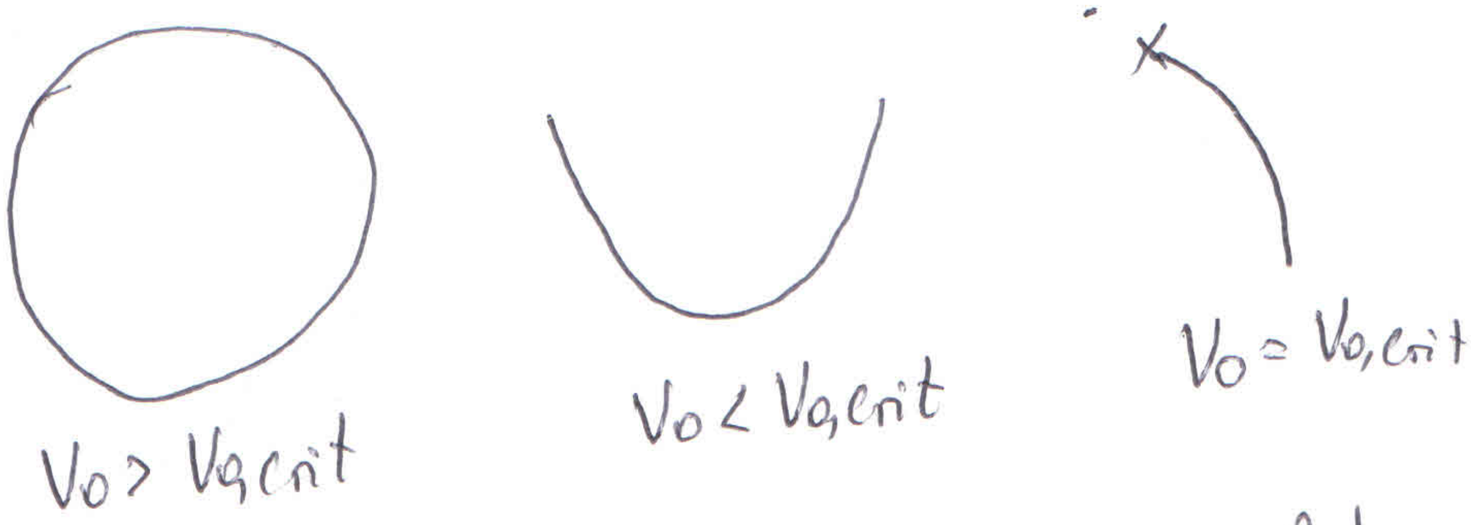


fig. 4.10. The image of the solution: $\{\theta(t), t>0\}$

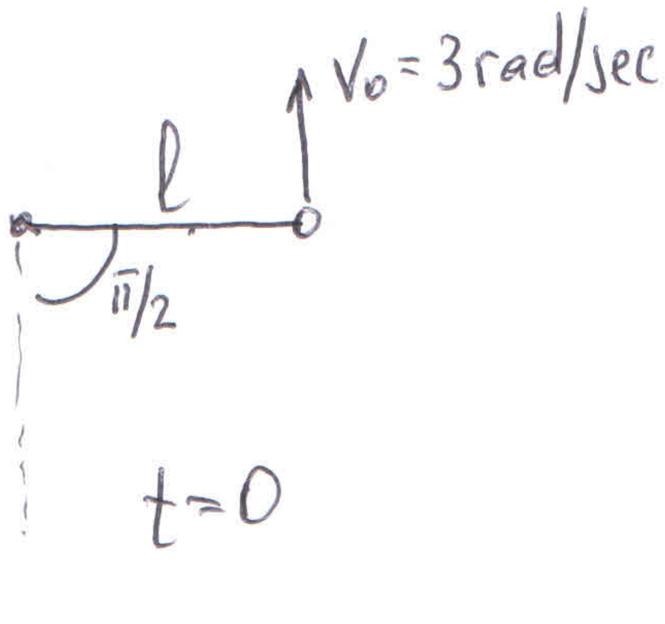


fig. 4.11. Problem in section 4.6.3: to find t_1.

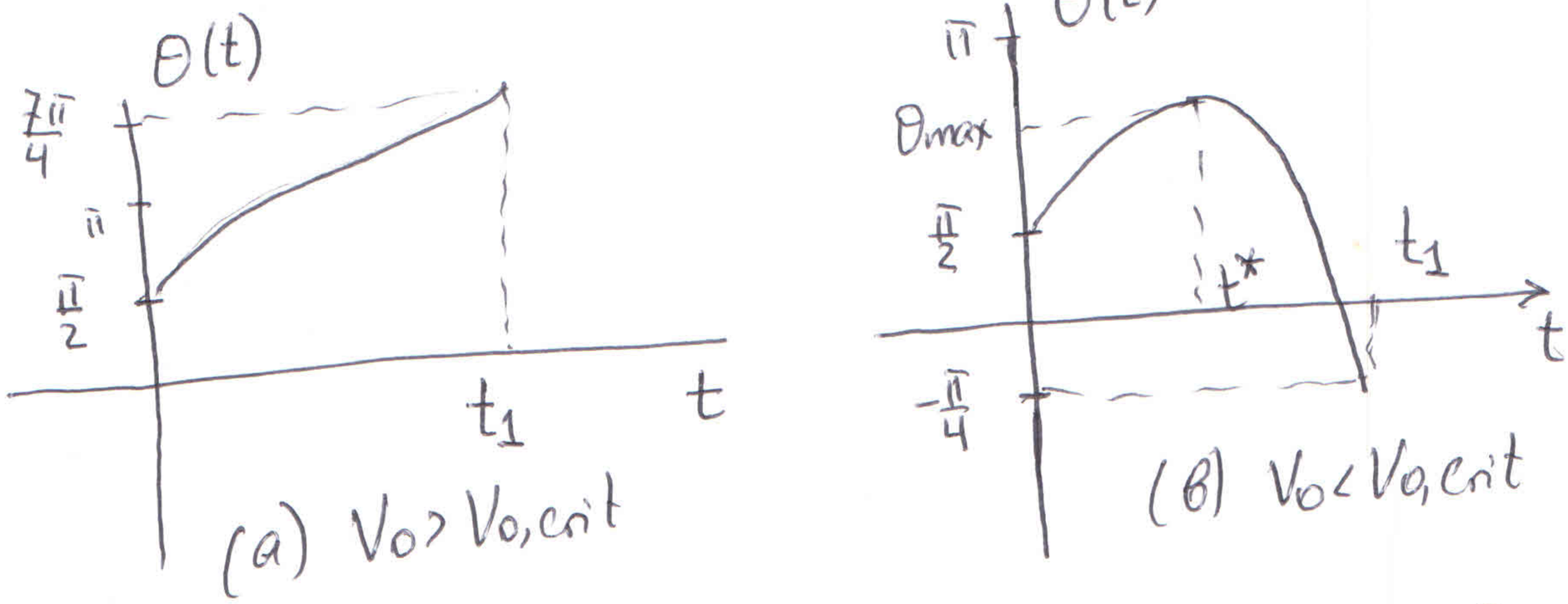


fig. 4.12. $\theta(t)$ as a function $\mathbb{R} \to \mathbb{R}$ if $V_0 > V_{0,crit}$ and $V_0 < V_{0,crit}$

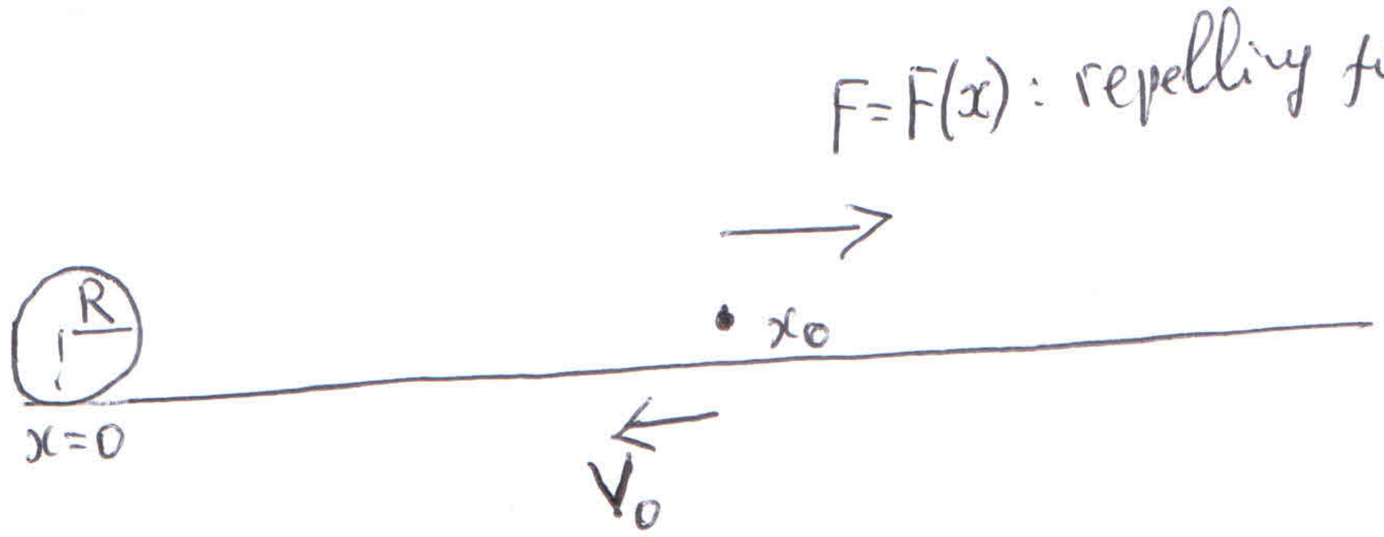


fig. 4.13. Another version of two problem (exercise 5).

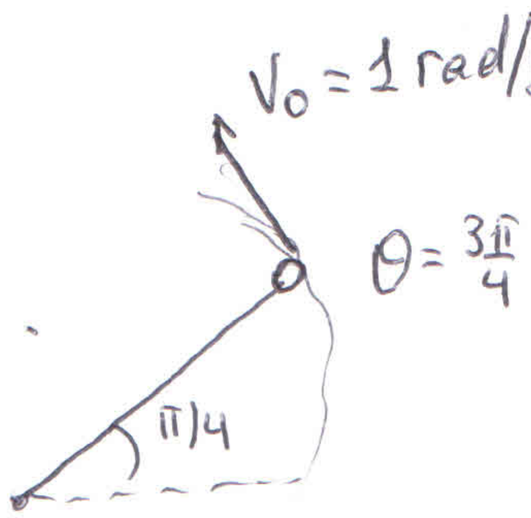


fig. 4.14. For exercise 8.