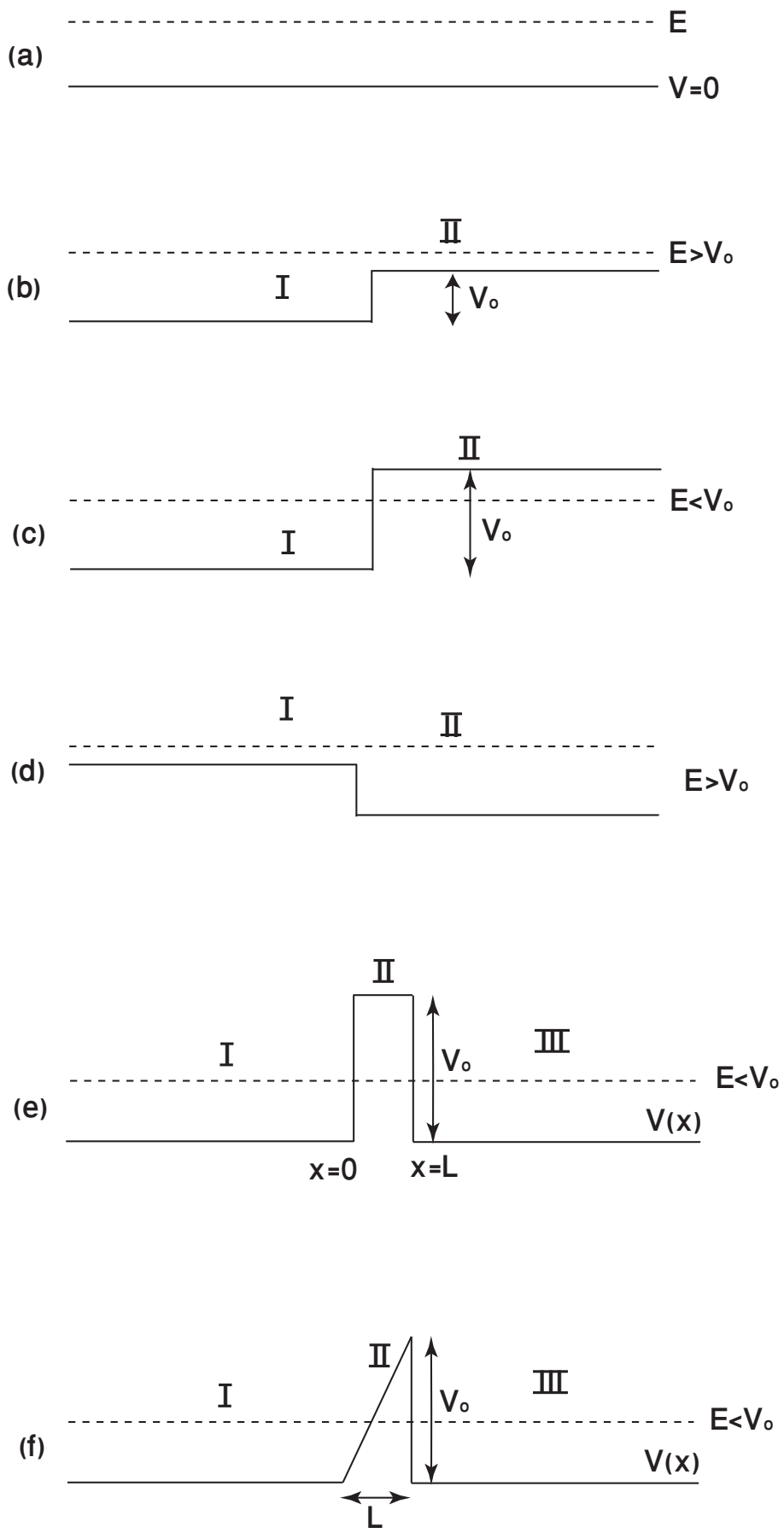
Tutorial 6: Modern Physics

1. Figures (a) through (f) show various kinds of potential steps and obstacles to an electron injected from the left, with energy E. $V(x)$ is shown by solid lines and E by dashed lines. Two or three regions (I, II and III) are also identified. In each case, discuss the following.

   (i) Fields (wavefunctions) in each region—their mathematical form and sketches of their real parts.

   (ii) Identify the discontinuities from where reflection of the single electron can take place.

   The figures are shown overleaf.


(a)
E
V=0
(b)
II
E>Vo
I
Vo
(c)
II
E<Vo
Vo
I
(d)
I
II
E>Vo
(e)
II
I
Vo
III
E<Vo
V(x)
x=0
x=L
(f)
II
I
Vo
III
E<Vo
V(x)
L

2. The equations for the reflection R and transmission T for light encountering a transparent film are essentially the same as a particle of energy E seeing a potential discontinuity while E always remains greater than the potential energy. Derive the value of the ratio between the wave numbers k_1 and k_2 if 50% of the light is always reflected at an interface.