A particle of charge $\boldsymbol{q}$ and mass $\boldsymbol{m}$, is moving in a one-dimensional harmonic potential of frequency $\boldsymbol{\omega}$. The particle is subject to a *weak* electric field $\boldsymbol{E}$.

Find the energy eigenvalues of the system
(a) By exact solution of the Schroedinger equation;
(b) By calculate the first nonzero correction using perturbation theory.

(a) Figure 1 below shows a non-polarized optical beam passing through an optical system consisting of two crossed polarizers. A third freely rotating polarizer is placed between of the two. Considering all polarizers to be ideal, i.e. without any spurious absorption or scatter. At what angle α_1 is the transmitted intensity the largest? What is the largest transmitted intensity?

(b) Figure 2 shows a similar arrangement but with two freely rotationg polarizers. At what angles α_1, α_2, is the transmitted intensity the largest and what is the largest transmitted intensity?

(c) The same as in (b) but with N polarizers at angles, α_1, α_2, α_3,... α_N .

(d) What is the transmitted intensity in the limit $N \rightarrow \infty$

Figure 1.

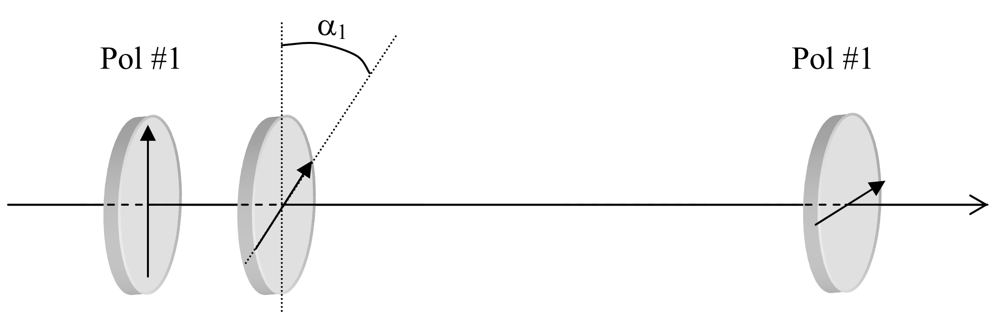


Figure 2.

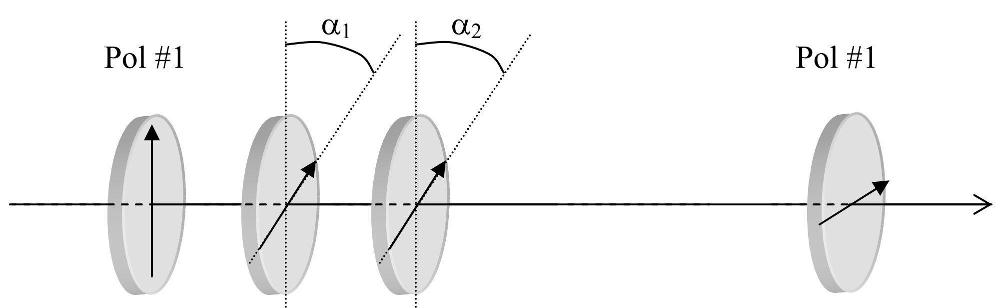
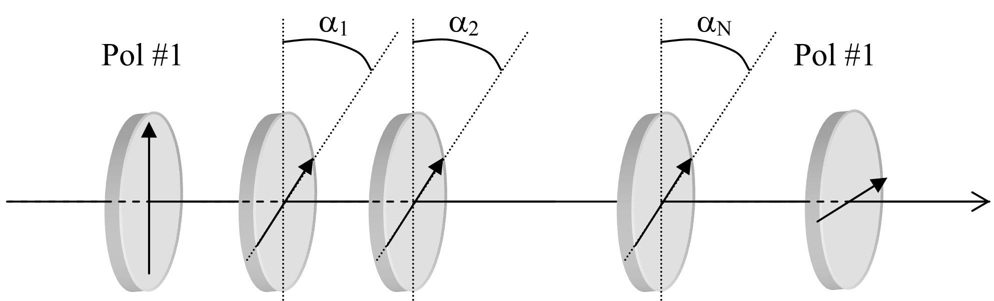


Figure 3.



The glow element of a *24 V* incandescent lamp is made of *0.1 mm* diameter tungsten wire. At the nominal temperature, $T=3200\ ^0C$ the lamp consumes *100 W* of electrical power. The electrical resistivity of tungsten is, $\rho = \rho_0 + \alpha(T - T_0)$, where $T_0 = 20\ ^0$C, $\rho_0 = 5.5\ 10^{-8}\ \Omega m$, $\alpha = 2.7\ 10^{-10}\ \Omega m\ K^{-1}$. The emitted black body radiation constitutes 40% of the consumed electrical power, independent of the temperature. Density of tungsten is $\rho_m = 19.3\ g\ cm^{-3}$, and the specific heat of tungsten is $c_p = 1.67\ J\ K^{-1}\ g^{-1}$.

How long does it take for the wire to heat up to $T=3200\ ^0C$, if at the moment the lamp is switched on the temperature is $T=20\ ^0C$?