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1)
Solution:

$$\begin{cases} n_{g_1} = \dfrac{c}{v_{g_1}} \\ \dfrac{\partial k}{\partial w} = \dfrac{1}{v_{g_1}} \end{cases} \qquad \begin{cases} n_{g_2} = \dfrac{c}{v_{g_2}} \\ \dfrac{\partial k}{\partial w} = \dfrac{1}{v_{g_2}} \end{cases}$$

$\therefore n_{g1} = 2 \qquad n_{g2} =$

2)
Solution:

$$\left.\frac{\partial^2 k}{\partial w^2}\right|_{w=0} = D_w$$

3)
solution:

$$i\frac{\partial}{\partial z}\tilde{V}(z,t) - \frac{D}{2}\frac{\partial^2}{\partial t^2}\tilde{V}(z,t) = 0$$