final Solutions

1. For any laser in steady state, gain = loss

So $g = 2\gamma l = \Gamma = 0.08$

$$\gamma = \frac{0.08}{2l} = \boxed{0.04\ m^{-1}}$$

2. Have

$$r_{13} = r_{xxz}$$
$$r_{41} = r_{yzx}$$
$$r_{43} = r_{yzz}$$

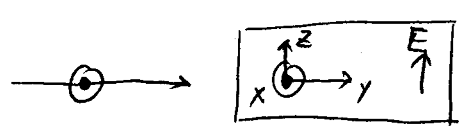
Index ellipsoid:

$$\frac{x^2}{n_o^2} + \frac{y^2}{n_o^2} + \frac{z^2}{n_e^2} + 2r_{13}x^2E_z + 2r_{41}yzE_x + 2r_{43}yzE_z = 1$$

If $n_o \neq n_e$, r_{41} & r_{43} terms will not give significant effect.

So use r_{13} term

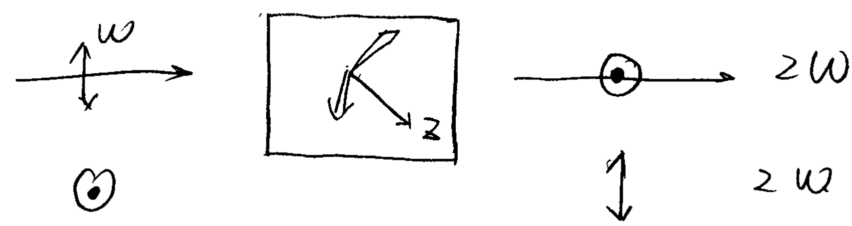
Apply E_z, polarize light along $\hat{x}$



$\vec{E} = E_z\hat{z}$

$\hat{\varepsilon} = \hat{x}$

3. $d_{11} = d_{xxx}$ and $d_{22} = d_{yyy}$, **Yes**



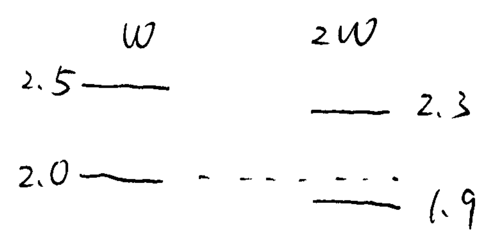
or

Same picture works in either case.

$d_{33} = d_{zzz}$, **NO**

Only way for a beam to have an Z_z component is if it is an extrodinary beam.
But can't phase match two e-beams

4.



Need $n_e(2\omega) = n_o(\omega)$

$$\frac{1}{n_o(\omega)^2} = \frac{\cos^2\theta}{n_o(2\omega)^2} + \frac{\sin^2\theta}{n_e(2\omega)^2}$$

$$\sin^2\theta = \frac{\frac{1}{n_o(\omega)^2} - \frac{1}{n_o(2\omega)^2}}{\frac{1}{n_e(2\omega)^2} - \frac{1}{n_o(2\omega)^2}} = \frac{\frac{1}{2.0^2} - \frac{1}{1.9^2}}{\frac{1}{2.3^2} - \frac{1}{1.9^2}} = 0.307$$

$$\boxed{\theta = 33.6^\circ}$$