

# Photonics

## Simulation Assignment

### Laser Diode

1.

Analytic formula are in the code. Results are:

$I_{tr} = 0.76896 \text{ mA}$

$I_{th} = 29.5778 \text{ mA}$

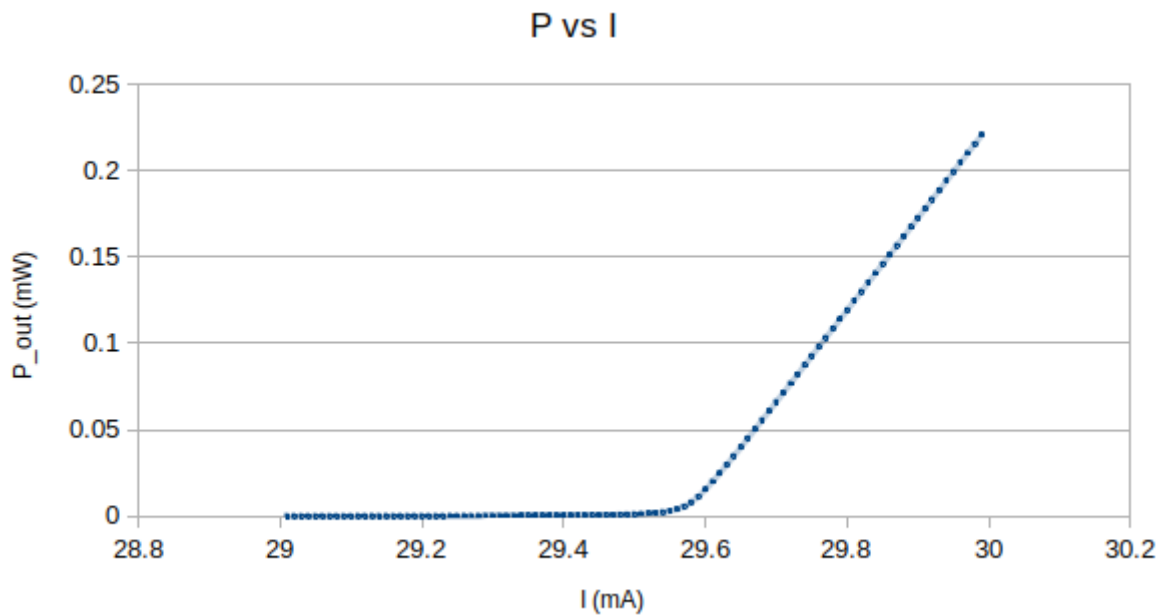
slope efficiency = 0.709911

time delay =  $1.38629 \times 10^{-6} \text{ ms}$  at  $2I_{th}$

2. [code attached]

3.

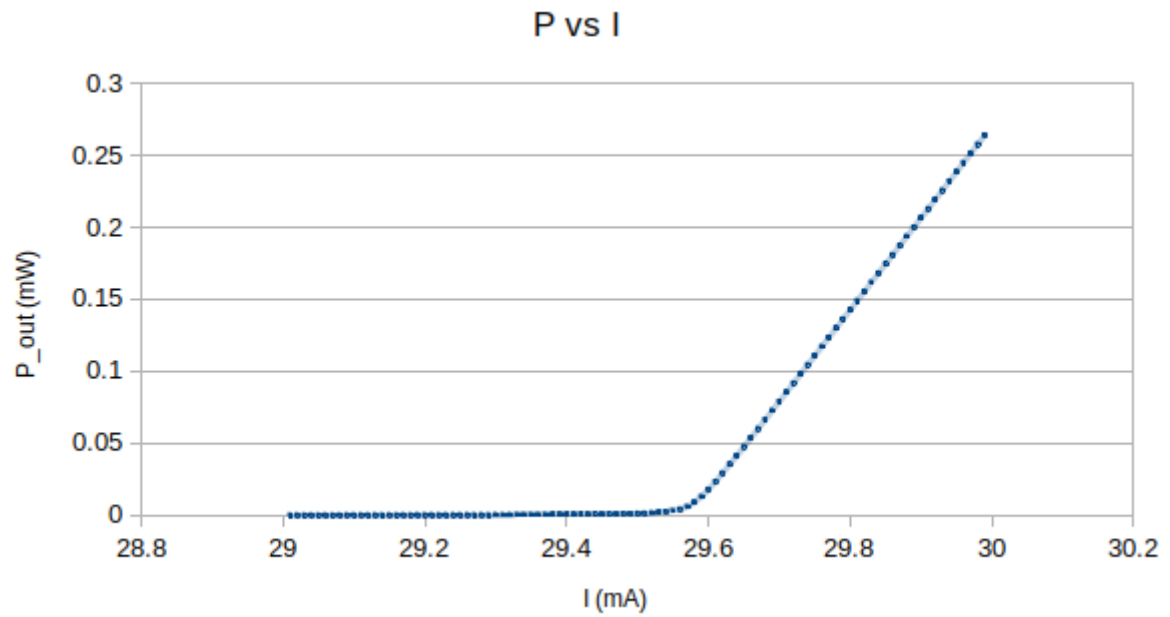
a.



Simulation shows the threshold current to be at 29.6 mA.

Slope efficiency = 0.53306

b.



Simulation shows the threshold current to be at 29.6 mA.  
 Slope efficiency = 0.63795

4.

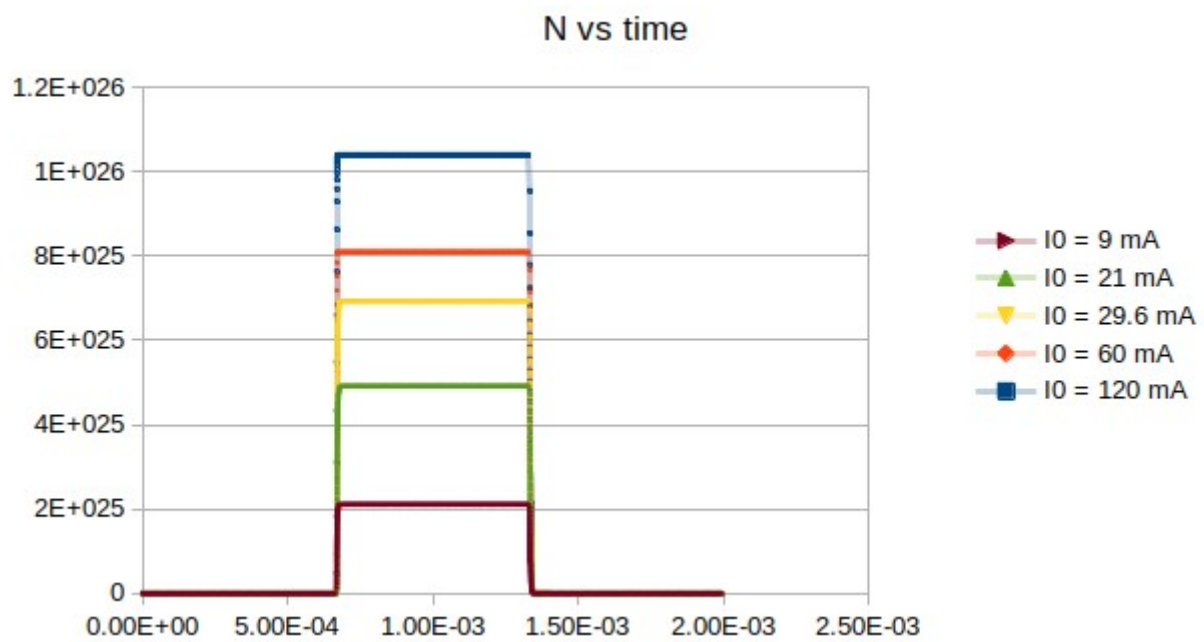
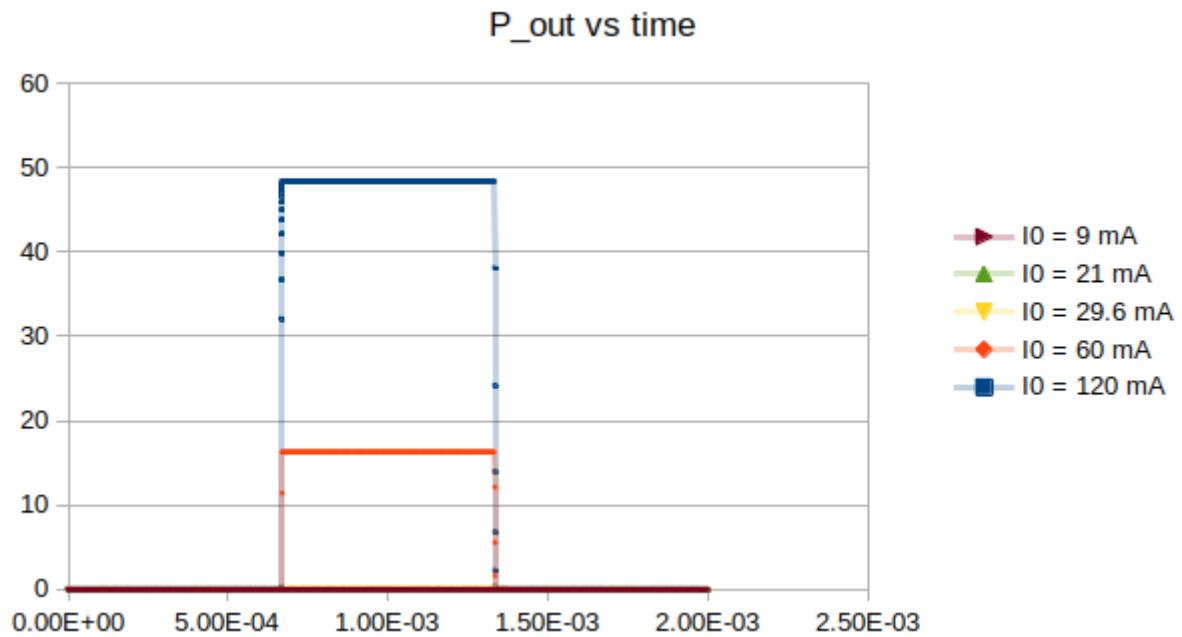
$a = 0.50 \times 10^{-20}$

More differential gain reduces the threshold current.

5.

$I_0$  values used:

9 mA  
 21 mA  
 29.6 mA  
 60 mA  
 120 mA



a.

Turn-on delay:

0.0105 ms

0.0165 ms

0.0388 ms

0.0030 ms

0.0041 ms

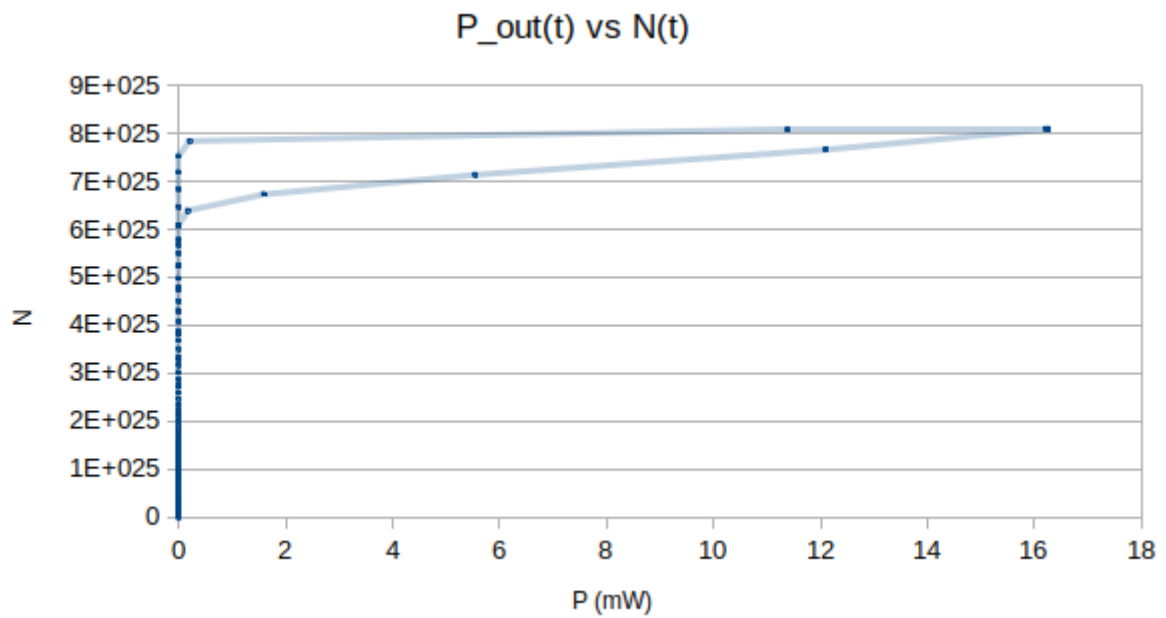
Was measured as the time between current turning on and reaching full lasing power, and is significantly higher than the analytical value.

b.

$P_{\text{out}}$  rises sharply when the threshold current is reached.

c.

[table attached]



d.

Oscillations are observed due to relaxation as  $N$  and  $N_p$  rise and fall opposite each other, and the  $P_{\text{out}}$  relates to the  $N_p$ .