Assignment 8

Due on 2021-03-17, 23:59 IST.

Instructions:

1. Answer all questions, all questions carry equal mark.
2. All answers have their usual meaning.
3. Only one of the options is correct.
4. Take care of the order in numerical problems, to match with the units given in the options (HCGQ).
5. The units in which answers have to be entered in all the blank type of questions.
6. In all the blank type of questions, only the numerical values have to be entered.

NOTE: You can see the correct answers after the last date of submission. Marks obtained in this quiz will not be counted towards your final score. You may take the quiz and submit it any number of times, and the latest submitted answers will be taken as your final submission.

1. State whether the following statement is TRUE or FALSE. 1 point

- The magnitude of the maximum intensity is represented as a horizontal line in the gain spectrum of a laser because the laser is almost constant over the wavelength range of the laser transition.

   Accepted Answers:
   - TRUE
   - FALSE

   No. the answer is incorrect.
   - Shape: 2
   - Accepted Answers: TRUE

2. A particular laser, oscillating in one longitudinal mode, when subjected to pump power of $P_{inc}$ and $P_{out}$ (given below) outputs power $P_{out}$ and $P_{out}$ respectively. Draw that $P_{inc} = P_{inc}$ (typical pump power). What is the relationship between gain coefficients at the laser's cavity length? 1 point

   Accepted Answers:
   - $\gamma_{inc} = \gamma_{inc}$
   - $\gamma_{inc} = \gamma_{out}$
   - $\gamma_{inc} = \gamma_{inc}$
   - $\gamma_{inc} = \gamma_{inc}$

   No. the answer is incorrect.
   - Shape: 3
   - Accepted Answers: $\gamma_{inc} = \gamma_{inc}$

3. Which of the following correctly represents the order of the time taken during the evolution of gain profile in a laser, when the laser is pumped at $P_{inc}$, over a time of $t = t_0$, to a switching time $t_1$, the time at which the gain reaches its transparency only $t_2$ the time at which gain reaches the threshold for the first time, $t_3$ the time at which the laser reach the transparency only $t_2$ the time at which gain reaches the threshold for the first time, $t_3$ the time at which the gain in the medium reaches its peak value.

   Accepted Answers:
   - $t_0 > t_1 > t_2 > t_3$
   - $t_0 > t_1 > t_2 > t_3$
   - $t_0 > t_1 > t_2 > t_3$
   - $t_0 > t_1 > t_2 > t_3$

   No. the answer is incorrect.
   - Shape: 1
   - Accepted Answers: $t_0 > t_1 > t_2 > t_3$

4. Which of the following cannot be inferred from the special gain profile of a laser shown in the figure below? 1 point

   Accepted Answers:
   - Only 1 longitudinal mode is lasing.
   - The gain at different frequencies is controlled by different groups of atoms.
   - A harmonic function can be described to represent the threshold gain coefficient.
   - The intensity of the longitudinal mode is $I_{max}$ at last but not at $I_{max}$

   No. the answer is incorrect.
   - Shape: 2
   - Accepted Answers: Only 1 longitudinal mode is lasing.

5. The following cannot be inferred from the special gain profile of a laser shown in the figure below? 1 point

   Accepted Answers:
   - Only 1 longitudinal mode is lasing.
   - The gain at different frequencies is controlled by different groups of atoms.
   - A harmonic function can be described to represent the threshold gain coefficient.
   - The intensity of the longitudinal mode is $I_{max}$ at last but not at $I_{max}$

   No. the answer is incorrect.
   - Shape: 2
   - Accepted Answers: Only 1 longitudinal mode is lasing.

6. A laser is operating in a single longitudinal mode. If the total gain in the cavity is $G_{total}$, then the gain per unit length of the laser is $G_{laser}$. The number of photons observed in the gain profile would be $\lambda^2$. (Write your answer as an integer)

   Accepted Answers:
   - Only $G_{total}$ is known.
   - Only $G_{laser}$ is known.
   - Only $G_{laser}$ and $G_{inc}$ are known.
   - Only $G_{laser}$ and $G_{out}$ are known.

   No. the answer is incorrect.
   - Shape: 3
   - Accepted Answers: Only $G_{total}$ is known.

7. Which one of the following statements is true for a simplified simplified model of a laser diode:

   Accepted Answers:
   - Only $\gamma_{inc}$ is known.
   - Only $\gamma_{laser}$ is known.
   - Only $\gamma_{laser}$ and $\gamma_{inc}$ are known.
   - Only $\gamma_{laser}$ and $\gamma_{out}$ are known.

   No. the answer is incorrect.
   - Shape: 3
   - Accepted Answers: Only $\gamma_{inc}$ is known.

8. If $\gamma_{inc}$ is 0.3, the beam of light having a radius of $1$ cm has a pump rate of $\lambda^2$. The total pump rate is $\lambda^2$. For the cavity length $l = 1$, the cavity length $l = 1$.

   Accepted Answers:
   - Only $\gamma_{inc}$ is known.
   - Only $\gamma_{laser}$ is known.
   - Only $\gamma_{laser}$ and $\gamma_{inc}$ are known.
   - Only $\gamma_{laser}$ and $\gamma_{out}$ are known.

   No. the answer is incorrect.
   - Shape: 3
   - Accepted Answers: Only $\gamma_{inc}$ is known.

9. The output from the laser in a 2D pulse of a pump rate of $\lambda^2$ at $t = 0$ and $\lambda^2$ at $t = 0$. The ratio $\lambda^2$ is $\lambda^2$.

   Accepted Answers:
   - Only $\gamma_{inc}$ is known.
   - Only $\gamma_{laser}$ is known.
   - Only $\gamma_{laser}$ and $\gamma_{inc}$ are known.
   - Only $\gamma_{laser}$ and $\gamma_{out}$ are known.

   No. the answer is incorrect.
   - Shape: 3
   - Accepted Answers: Only $\gamma_{inc}$ is known.

10. State whether the following statement is TRUE or FALSE. 1 point

| The output from the cavity laser, operating above the threshold, suddenly drops down if the reflectivity of the output mirror is reduced below a certain value. This is because the cavity laser has excess at the gain point. |
| TRUE |
| FALSE |

No. the answer is incorrect.
- Shape: 2
- Accepted Answers: TRUE

(Write your answer as an integer without using expressions)