

Course outline

How does an NPTEL online course work?

Week 1

Week 2

Week 3

Laser Rate Equations: 2-Level System

Laser Rate Equations: 3-Level System

Laser Rate Equations: 4-Level System

Week 3 Feedback Form

Quiz : Assignment 3

Week 4

Week 5

Week 6

Week 7

Week 8

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Week 12

Assignment Solutions

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Assignment 3

The due date for submitting this assignment has passed.

Due on 2021-02-10, 23:59 IST.

As per our records you have not submitted this assignment.

Instructions:

1. Answer all questions; all questions carry equal mark.
2. All symbols have their usual meanings.
3. Only one of the options is correct.
4. Take care of the units in numericals, to match with the units given in the options (of MCQs), and the units in which answers have to be entered (in fill in the blank type of questions).
5. In the fill in 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 be counted towards your final score. You can 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**

In the presence of an external pump, the population of atoms in the atomic energy levels is inversely proportional to the lifetimes of the respective levels.

- TRUE
 FALSE

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 FALSE

- 2) State whether the following statement is TRUE or FALSE **1 point**

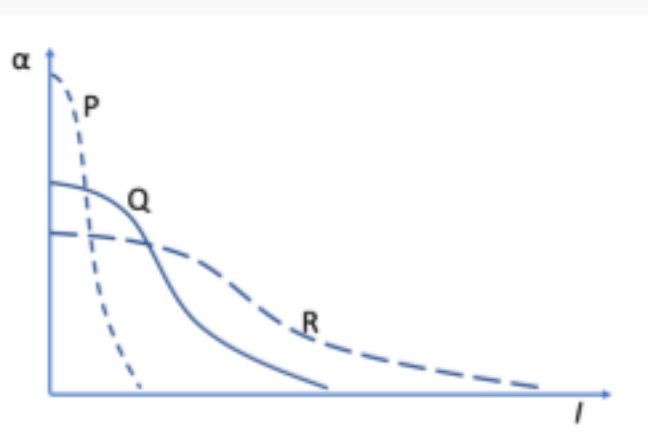
In the presence of an external pump, population inversion can be achieved in a 2-level atomic system only in a transient state.

- TRUE
 FALSE

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 TRUE

- 3) The variation of absorption coefficient (α) with intensity (I) for three different materials P, Q and R is shown below. Which one of them is the most suitable material to be used as a saturable absorber? **1 point**

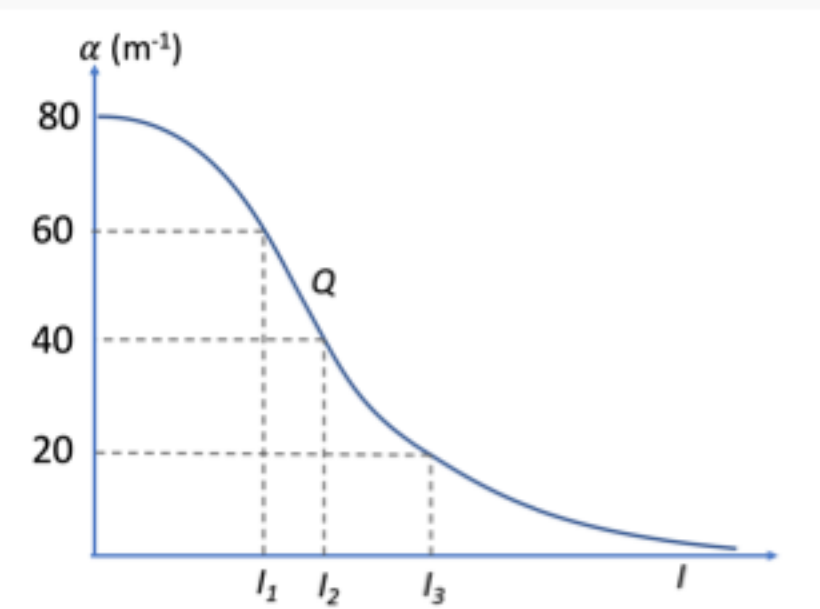


- P
 Q
 R

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 P

- 4) The absorption coefficient (in m^{-1}) at different intensities is shown for the material Q. The saturation intensity of Q is - **1 point**



- I_1
 I_2
 I_3

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 I_2

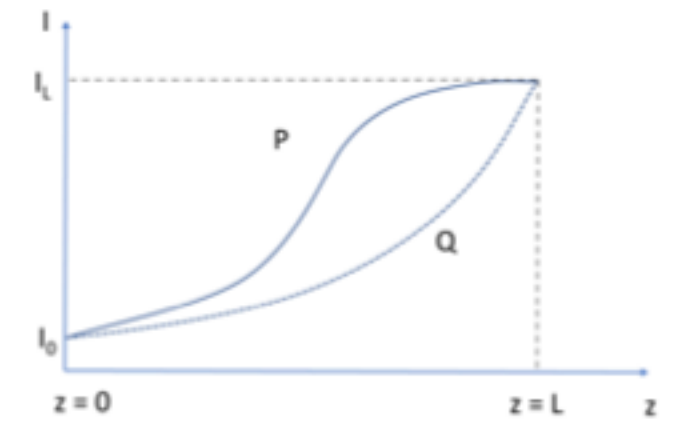
- 5) Which one of the following conditions would lead to population inversion in a 3-level atomic system? (W_p is the pumping rate and T_{ij} is the transition rate from level i to level j ; $i, j = 1, 2, 3$) **1 point**

- $T_{32} = 10^5 \text{ s}^{-1}, T_{21} = 10^4 \text{ s}^{-1}, W_p = 2 \times 10^4 \text{ s}^{-1}$
 $T_{32} = 10^4 \text{ s}^{-1}, T_{21} = 10^5 \text{ s}^{-1}, W_p = 5 \times 10^3 \text{ s}^{-1}$
 $T_{32} = 10^3 \text{ s}^{-1}, T_{21} = 10^5 \text{ s}^{-1}, W_p = 2 \times 10^5 \text{ s}^{-1}$
 $T_{32} = 10^5 \text{ s}^{-1}, T_{21} = 10^4 \text{ s}^{-1}, W_p = 5 \times 10^3 \text{ s}^{-1}$

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 $T_{32} = 10^5 \text{ s}^{-1}, T_{21} = 10^4 \text{ s}^{-1}, W_p = 2 \times 10^4 \text{ s}^{-1}$

- 6) The intensity build-up along the length of two amplifying media P and Q is shown below. If I_s^P and I_s^Q are the saturation intensities of P and Q respectively, then which one of the following statements is correct? **1 point**



- $I_s^P \gg I_L$
 $I_s^Q \ll I_L$
 $I_s^Q \gg I_0$
 $I_s^P \ll I_0$

No, the answer is incorrect.
 Score: 0

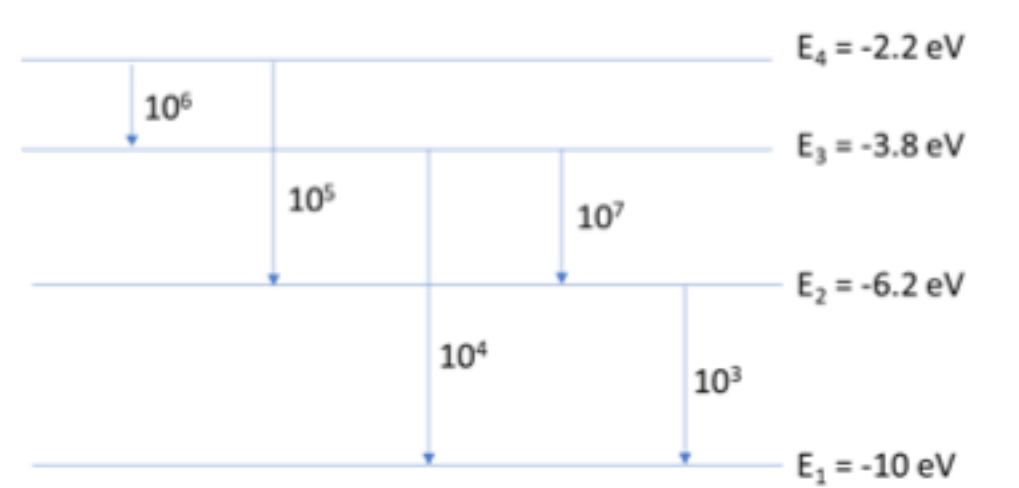
Accepted Answers:
 $I_s^Q \gg I_0$

- 7) In a particular 3-level laser amplifier, given that $E_3 - E_1 = 2.5 \text{ eV}$, $\tau_{21} = 5 \text{ ms}$ and the total number of active atoms $N = 10^{19} \text{ cm}^{-3}$. The threshold pump power for amplification (per 1 cm^3 of the material) is approximately _____ W.

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 (Type: Range) 390,410

- 8) Atomic energy levels of a certain gas which acts as an amplifying medium is shown below: E_1 is the ground state energy. **1 point**



- 4-level laser amplifier
 3-level laser amplifier
 2-level laser amplifier

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 3-level laser amplifier

- 9) In question no. 8 above, which one of the following is the lasing transition? **1 point**

- Level 3 to 1
 Level 2 to 1
 Level 3 to 2
 Level 4 to 2

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 Level 2 to 1

- 10) Which one of the following statements with reference to 3-level and 4-level lasers is correct? **1 point**

- The magnitude of population inversion required for the operation of 4-level lasers is much higher than that for a 3-level lasers
 A 4-level laser can operate even if more than half of the total number of atoms are in the ground state
 The threshold pump power in the case of a 4-level laser is higher than that of a 3-level laser
 3-level lasers are usually more efficient than 4-level lasers

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 A 4-level laser can operate even if more than half of the total number of atoms are in the ground state