

Solutions

2.1 C Each half-value layer halves the intensity: $(1/2)^3=1/8$.

Compare the rejected options: $1/3$; $1/6$; $1/9$; $1/16$. Use the stated model and conditions.

2.2 B Boltzmann populations give $N_2 < N_1$, so absorption wins without pumping.

Compare the rejected options: the upper level is always more populated; spontaneous emission is forbidden; the cavity modes vanish; photons cease to be coherent. Use the stated model and conditions.

2.3 600. $c/(2L)=3 \times 10^8/0.5=6 \times 10^8$ Hz=600 MHz.

2.4 False. Scattered build-up adds transmission; the exponential assumes narrow-beam geometry.

3.1 One round trip multiplies intensity by $R_1 R_2 e^{2(g-\alpha)L}$. Threshold requires that factor equal one, so $g_{th} = \alpha + \ln[1/(R_1 R_2)]/(2L)$. Above threshold unsaturated gain must exceed this loss; steady lasing involves saturation. Award round trip, threshold condition, logarithmic result and convention/saturation. An amplitude coefficient convention would introduce a factor of two and must be declared.