Assignment 9

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2018-10-03, 23:59 IST.

1) For a centrosymmetric media, if there is additional symmetry of mirror reflection yz plane with the transformation matrix \[
\begin{pmatrix}
-1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1
\end{pmatrix}
\]
then which one of the following is correct?
(a) \(\chi^{(3)}_{xxx} \neq 0\); (b) \(\chi^{(3)}_{xxy} = 0\); (c) \(\chi^{(3)}_{xyy} \neq 0\); (d) \(\chi^{(3)}_{xyy} = 0\).

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b)

2) The relation between nonlinear index of refraction \(n_2\) and \(\chi^{(3)}\) is (the symbols have their usual meaning)
(a) \(n_2 = \frac{3}{8\varepsilon_0 n^2 c} \chi^{(3)}\)  (b) \(n_2 = \frac{3}{4\varepsilon_0 n c} \chi^{(3)}\)  (c) \(n_2 = \frac{3}{4\varepsilon_0 n^2 c} \chi^{(3)}\)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c)

3) The change in refractive index (\(\Delta n\)) due to Kerr effect when a light with power falls on a medium of cross-sectional area \(1\, \text{mm}^2\) \((n_2 = 6 \times 10^{-18} \, \text{m}^2/\text{W})\)
(a) \(6 \times 10^{-14}\)  (b) \(6 \times 10^{-12}\)  (c) \(3 \times 10^{-14}\)  (d) \(3 \times 10^{-13}\)
The following equation dictates the propagation of a wave of frequency $\omega$ drives the third order nonlinear polarization at the same frequency. $\frac{dA}{dz} = i \frac{3\omega \chi^{(3)}}{8nc} |A|$

If the complex amplitude $A(z) = u(z)e^{i\phi(z)}$ then the evolution equation for phase $\phi$ is

(a) $\int_z \frac{3\omega \chi^{(3)}}{8nc} dz$
(b) $\int_z \frac{3\omega \chi^{(3)}}{4nc} |A| dz$
(c) $\int_z \frac{3\omega \chi^{(3)}}{4nc} |A|^2 dz$
(d) $\int_z \frac{3\omega \chi^{(3)}}{8nc} |A|^2 dz$

Follow the above question (Q.4), what will be the maximum frequency shift $\Delta \nu$ self-phase modulation for an optical pulse that has a Gaussian temporal profile $I(t)$ by $I(t) = I_0 e^{-\frac{2t^2}{T_0^2}}$

(a) $\frac{2n_2I_0}{T_0} e^{-\frac{2\tau}{T_0^2}}$
(b) $\frac{2n_2I_0 k_0\pi}{T_0} e^{-\frac{2\tau}{T_0^2}}$
(c) $\frac{2n_2I_0 k_0\pi}{T_0} e^{-\frac{2\tau}{T_0}}$
(d) $\frac{2n_2I_0}{T_0}$

Follow the above question (Q.5), the maximum frequency shift per unit length ($k$ unit) will be (where $T_0 = 20 fs, I_0 = 1GW/cm^2, n_2 = 10^{-16} cm^2/W$ and the central frequency of the input radiation is $10^{14} Hz$.)

(a) $10^{16}$
(b) $2 \times 10^{15}$
(c) $2 \times 10^{13}$
(d) $2 \times 10^{-15}$
7) Follow the above question (Q.6), the output frequency from a 2 cm long crystal is:
(a) $1.004 \times 10^{13}$  
(b) $1.004 \times 10^{14}$  
(c) $1.004 \times 10^{15}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b)

8) The number of independent susceptibility tensor elements ($\chi^{(3)}$) for centrosymmetric crystals
(a) 1  
(b) 2  
(c) 3  
(d) 4

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c)

9) The process $\chi^{(3)}_{xxyy}(\omega_1; \omega_2, \omega_3, \omega_4) = \chi^{(3)}_{yyxx}(\omega_1; \omega_2, \omega_3, \omega_4)$ transforms under
(a) inversion symmetry  
(b) permutation symmetry  
(c) rotation-inversion symmetry

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

10) The process $\chi^{(3)}_{xxyy}(\omega_1; \omega_2, \omega_3, \omega_4) = \chi^{(3)}_{yyxx}(\omega_3; -\omega_4, \omega_1, -\omega_2)$ transforms under
(a) inversion symmetry  
(b) permutation symmetry  
(c) rotation-inversion symmetry

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b)