(5) The motion of a particle of mass 'm' in one dimension is described by the Hamiltonian $H = \frac{p^2}{2m} + \frac{1}{2} m\omega^2 x^2 + \lambda x$ what is the difference between the quantized energies of the first two levels

(A) $\hbar\omega - \lambda x$ (B) $\hbar\omega + \lambda x$ (C) $\hbar\omega + \frac{\lambda^2}{2m\omega^2}$ (D) $\hbar\omega$

(E) None of the above

<u>Here</u>

$$V = \frac{1}{2} m\omega^2 x^2 + \lambda x$$

$$= \frac{1}{2} m\omega^2 \left(x^2 + 2x\frac{\lambda}{m\omega^2} + \frac{\lambda^2}{m^2\omega^4} - \frac{\lambda^2}{m^2\omega^4}\right)$$

$$= \frac{1}{2} m\omega^2 \underbrace{\left(x^2 + \frac{\lambda}{m\omega^2}\right)^2} - \frac{\lambda^2}{m^2\omega^4}$$

$$E_n = \left(n+\frac{1}{2}\right)\hbar\omega - \frac{\lambda^2}{m^2\omega^4}$$

$$E_1 - E_0 = \frac{3}{2}\hbar\omega \cancel{-\frac{\lambda^2}{m^2\omega^4}} - \frac{1}{2}\hbar\omega \cancel{+\frac{\lambda^2}{m^2\omega^4}}$$

$$\boxed{E_1 - E_0 = \hbar\omega}$$

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