Fine structure 3

Consider the following formula for hydrogen energy levels where $j = |l \pm 1/2|$.

$$E_{nj} = -\mu c^2 \left[1 - \frac{1}{\sqrt{1 + \left(\frac{\alpha}{n - j - \frac{1}{2} + \sqrt{\left(j + \frac{1}{2}\right)^2 - \alpha^2}} \right)^2}} \right] \tag{1}$$

Use (1) to verify the following transitions from $n = 3$ to $n = 2$. (Recall that orbitals s, p, and d correspond to $l = 0, 1, 2$.)

Transition	Wavelength (nm)
$3_{s1/2} \to 2_{p1/2}$	656.457
$3_{s1/2} \to 2_{p3/2}$	656.473
$3_{p1/2} \to 2_{s1/2}$	656.457
$3_{p3/2} \to 2_{s1/2}$	656.452
$3_{d3/2} \to 2_{p1/2}$	656.452
$3_{d3/2} \to 2_{p3/2}$	656.468
$3_{d5/2} \to 2_{p3/2}$	656.466