$$e_v = \sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right)$$

$$e_n = \sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right)$$

$$J = \begin{bmatrix} 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} -2 \left(-O_j + V_j \right) \delta_{1j} S_{i,j}^2 \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} -2 \left(-O_j + V_j \right) \delta_{2j} S_{i,j}^2 \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} -2 \left(-O_j + V_j \right) \delta_{3j} S_{i,j}^2 \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} 2 \left(-O_j + V_j \right)^2 \delta_{1i} \delta_{1j} S_{i,j} \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} 2 \left(-O_j + V_j \right)^2 \delta_{1i} \delta_{2j} S_{i,j} \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} 2 \left(-O_j + V_j \right)^2 \delta_{1i} \delta_{3j} S_{i,j} \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} 2 \left(-O_j + V_j \right)^2 \delta_{2i} \delta_{2j} S_{i,j} \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} 2 \left(-O_j + V_j \right)^2 \delta_{2i} \delta_{3j} S_{i,j} \\ 2 \left(\sum_{i=1}^{3} \left(-g^2 + \sum_{j=1}^{3} \left(-O_j + V_j \right)^2 S_{i,j}^2 \right) \right) \sum_{\substack{1 \le j \le 3 \\ 1 \le i \le 3}} 2 \left(-O_j + V_j \right)^2 \delta_{3i} \delta_{3j} S_{i,j} \end{bmatrix}$$