51. (a) According to Eq. 41-26, $f \propto (Z-1)^2$, so the ratio of energies is (using Eq. 39-2) $f/f' = [(Z-1)/(Z'-1)]^2$.

(b) We refer to Appendix F. Applying the formula from part (a) to $Z = 92$ and $Z' = 13$, we obtain

$$\frac{E}{E'} = \frac{f}{f'} = \left(\frac{Z-1}{Z'-1}\right)^2 = \left(\frac{92-1}{13-1}\right)^2 = 57.5 \ .$$

(c) Applying this to $Z = 92$ and $Z' = 3$, we obtain

$$\frac{E}{E'} = \left(\frac{92-1}{3-1}\right)^2 = 2070 \ .$$