

# 5.73

## Quiz 29

1.

$$E_{n\ell} = -\mathfrak{R}/(n - \delta_\ell)^2 \quad n \text{ is the principal quantum number and} \\ \delta_\ell \text{ is the quantum defect}$$

A. Explain, based on the effective radial charge distribution of the ion-core,  $Z^{\text{eff}}(r)$  [ $Z^{\text{eff}}(r)$  is  $Z$  at  $r = 0$  and  $1$  at  $r = \infty$ ], why the quantum defect,  $\delta_l$ , is positive.

B. Predict, based on  $Z^{\text{eff}}(r)$  and the centrifugal term in the potential  $[\ell(\ell+1)/2\mu r^2]$ , whether  $\delta_l$  is larger or smaller than  $\delta_{l'}$ . Explain.

C. If  $\bar{E}_n = (E_{ns} + E_{np})/2$  and  $\Delta = \delta_l - \delta_{l'}$ , derive  $\Delta E_n \equiv (E_{np} - E_{ns}) \approx \frac{2\mathfrak{R}\Delta}{n^3}$ .

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