Q4. $$\hat{u}_i(r) = c_i \int_{k_{i-1}}^{k_i} dk \sin kr.$$

$$= c_i \left[-\frac{\cos kr}{r} \right]_{k_{i-1}}^{k_i}$$

From Q3, $$c_i = \sqrt{\frac{2}{\pi \Delta k_i}}$$

$$\underline{\hat{u}_i(r) = \sqrt{\frac{2}{\pi \Delta k_i}} \left\{ \frac{\cos k_{i-1} r}{r} - \frac{\cos k_i r}{r} \right\}.}$$