

Pick $p(w|q) := \frac{tf_{w,q}}{|q|} = \frac{1}{|q|}$

$$D_{KL}(p(w|q) || p(w|d)) \stackrel{rank}{=} - \sum_w p(w|q) \log p(w|d)$$
$$= - \sum_w \frac{1}{|q|} \log p(w|d)$$