Q2

(1) is true . For that note that all s1 sparse vectors are s2 sparse also (as s1 sparse have atmost s1 non zero elements, they don't have greater than s2 non zero elements) , hence if the RIC constanr for s2 is δ_{2s} , then all the s2 sparse vectors θ obey

$$(1-\delta_{s2})||\theta||^2 \leq ||A\theta||^2 \leq (1+\delta_{s2})||\theta||^2$$

(we can always find a δ_{s2} for a matrix A(as we have seen the bounds on max value of $\frac{||A\theta||^2}{||\theta||^2}$ in Q1 , though it may be large in which case A doesn't obey RIP of order s2)

Now let v be any s1 sparse vector , since it is also s2 sparse , hence all s1 sparse vectors v , satisfy the above inequality ,

$$(1-\delta_{s2})||v||^2 \leq ||Av||^2 \leq (1+\delta_{s2})||v||^2$$

We need to find δ_{s1} for s1 sparse vectors , we already know that δ_{s2} satisfies the inequality for s1 sparse vectors. Since δ_{s1} is the smallest constant α satisfying the inequality

$$(1-\alpha)||v||^2 \leq ||Av||^2 \leq (1+\alpha)||v||^2$$

and $\alpha = \delta_{s2}$ satisfies the inequality , hence δ_{s1} is atleast as small as δ_{s2} (and can be even smaller) and hence we get

$$\delta_{s1} \leq \delta_{s2}$$