1. No. The formula $\lim_{n\to\infty}(n\,a_n) = n$ does not make sense.

2. We have $-2^{-n} \leq (\sin n) \leq 2^{-n}$. Since $2^{-n} \to 0$, the Sandwich Theorem implies that the sequence converges to 0.

3. $$\lim_{n\to\infty}\left(\sqrt{n+1}-\sqrt{n}\right) = \lim_{n\to\infty}\frac{1}{\sqrt{n+1}+\sqrt{n}} = 0$$
   because $\left(\sqrt{n+1}-\sqrt{n}\right)\left(\sqrt{n+1}+\sqrt{n}\right) = 1$.

4. $$\lim_{n\to\infty}\left(\frac{c^{2n}-1}{c^{2n}+1}\right) = \frac{\lim_{n\to\infty} c^{2n}-1}{\lim_{n\to\infty} c^{2n}+1} = -1 \quad \text{if } |c|<1;$$
   $$\lim_{n\to\infty}\left(\frac{c^{2n}-1}{c^{2n}+1}\right) = \frac{1-\lim_{n\to\infty} c^{-2n}}{1+\lim_{n\to\infty} c^{-2n}} = 1 \quad \text{if } |c|>1;$$
   $$\lim_{n\to\infty}\left(\frac{c^{2n}-1}{c^{2n}+1}\right) = 0 \quad \text{if } |c|=1$$

5. Assume that $a_n \to +\infty$. Then for each R there exists positive n_R such that $a_n > R$ for all $n > n_R$. It other words, for each R there are only finitely many elements a_n which are smaller than R. It follows that $s_k = \sup_{n\geq k} a_n = +\infty$ for all k and $r_k = \inf_{n\geq k} a_n \geq R$ for all sufficiently large k. The latter implies that $r_k \to +\infty$.

   Now assume that $\liminf a_n = \limsup a_n = +\infty$. Then $r_k \to \infty$ as $k \to \infty$. Since $r_k \leq a_k$ for all k, it follows that $a_n \to +\infty$ as $n \to \infty$