3. In each of the following, if the given statement is true for all sequences $\{a_n\}_{n=1}^{\infty}$, then mark the □ to the left of TRUE with a ✘; otherwise, mark the □ to the left of FALSE ✘ and give a counterexample. No explanation is required.

a. If $a_n < a_{n+1}$ for all $n \geq 1$, then $\lim_{n\to\infty} a_n = \infty$.

□ TRUE

☒ FALSE, because it does not hold for $a_n = \boxed{-\frac{1}{n}}$ for $n \geq 1$

b. If $\lim_{n\to\infty} a_n = 0$, then $\sum_{n=1}^{\infty} a_n$ converges.

□ TRUE

☒ FALSE, because it does not hold for $a_n = \boxed{\frac{1}{n}}$ for $n \geq 1$

c. If $\sum_{n=1}^{\infty} a_n$ converges, then $\{a_n\}_{n=1}^{\infty}$ converges.

☒ TRUE

□ FALSE, because it does not hold for $a_n = \boxed{}$ for $n \geq 1$

d. If $0 < \frac{1}{2^n} < a_n$ for all $n \geq 1$, then $\sum_{n=1}^{\infty} a_n$ diverges.

□ TRUE

☒ FALSE, because it does not hold for $a_n = \boxed{\frac{1}{2^{n-1}}}$ for $n \geq 1$

e. If $0 < a_n < \frac{1}{n}$ for all $n \geq 1$, then $\sum_{n=1}^{\infty} a_n$ converges.

□ TRUE

☒ FALSE, because it does not hold for $a_n = \boxed{\frac{1}{2n}}$ for $n \geq 1$