1. [5 points] Let a_n be a sequence of positive numbers such that $\sum_{n=1}^{\infty} a_n = 4$, and let S_n be a sequence defined by $S_n = a_1 + a_2 + \cdots + a_n$. **No justification necessary.**

a. [2 points] Find the following limits. Write DNE if the limit does not exist or is ∞ or $-\infty$.

i. $\lim_{n\to\infty} a_n =$ **0** **ii.** $\lim_{n\to\infty} S_n =$ **4**

b. [3 points]
Circle all statements which **must be true**.

i. a_n is increasing
ii. a_n is decreasing
iii. S_n is increasing
iv. S_n is decreasing
v. S_n is bounded
vi. None of these

2. [5 points] Calculate $\int_0^{\infty} \frac{2}{1+x^2}\,dx$. **Show all your work using correct notation.** Evaluation of integrals must be done **without a calculator.**

Solution:

$$\begin{aligned}\int_0^{\infty} \frac{2}{1+x^2}\,dx &= \lim_{b\to\infty} \int_0^{b} \frac{2}{1+x^2}\,dx \\ &= \lim_{b\to\infty} 2\arctan(x)\Big|_0^{b} \\ &= \lim_{b\to\infty} 2\arctan(b) - 2\arctan(0) \\ &= 2\cdot\frac{\pi}{2} - 0 \\ &= \pi\end{aligned}$$