1. [11 points] There is a classic result in mathematics, which states that the number of prime numbers less than any number $x \geq 2$ is approximated by the function $\mathrm{li}(x) = \int_2^x \frac{dt}{\ln t}$.

a. [3 points] Is $\mathrm{li}(x)$ increasing, decreasing, or neither for $x \geq 2$? Provide justification for your answer.

b. [3 points] Is $\mathrm{li}(x)$ concave up, concave down, or neither for $x \geq 2$? Provide justification for your answer.

c. [5 points] Using Integration by Parts, put $\mathrm{li}(x)$ into the form

$$\mathrm{li}(x) = f(x) + \int_2^x \frac{dt}{(\ln t)^2}.$$

What is $f(x)$?