1. Integrate.

(a) \[2 \int_0^{\pi/4} \tan x \sec^2 x \, dx\]

(b) \[4 \int_0^{\sqrt{3}} \frac{1 + x}{1 + x^2} \, dx\]

2. \[\int \frac{dx}{\sqrt{x(1-x)}}\]

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1 This problem came from an old Soviet book of calculus problems I stumbled upon a few days ago.
3. On the Chapter 5 Thing we showed that for $a > 0$, 
\[ \int \frac{du}{a^2 + u^2} = \frac{1}{a} \arctan \left( \frac{u}{a} \right) + C. \]

(a) For $a > 0$, find a similar general form for 
\[ \int \frac{du}{\sqrt{a^2 - u^2}}. \]

(b) Using what you found above, integrate 
\[ \int \frac{dx}{\sqrt{9 - 4x^2}}. \]

4. Sketch the region between the graphs of $y = \cos x$ and $y = \sin x$ for $x \in [0, \pi/2]$. Find the area of the region.