$\sin x$ is increasing on $[0, \pi/2]$

$\therefore U(f, P_n) = \frac{\pi}{6}\left(\sin\pi/6 + \sin\pi/3 + \sin\pi/2\right)$

$= \frac{\pi}{6}\left(\frac{1}{2} + \frac{\sqrt{3}}{2} + 1\right)$

$= \frac{\pi}{2}\left(3+\sqrt{3}\right)$