Engineered nanoparticles (NPs) (particle sizes ranging from 1-100 nm) have unique physical and chemical properties that differ fundamentally from their macro-sized counterparts. In addition to their smaller particle size, nanoparticles possess unique characteristics such as large surface to volume ratio and higher chemical reactivity, which are conducive for their application in environmental remediation, especially adsorption of target contaminants. In this study, we examined the sorption of arsenite (As (III)) and arsenate (As (V)) on amorphous and crystalline TiO$_2$ nanoparticles. Macroscopic investigations on arsenic sorption indicated that maximum As (V) coverage on both crystalline and amorphous TiO$_2$ occurred in the pH range of 3.8-6.5. The effect of pH on As (III) sorption onto amorphous TiO$_2$ was less pronounced, in comparison to crystalline TiO$_2$. XAS analysis provided evidence of partial As (III) oxidation on amorphous TiO$_2$ and not on the crystalline TiO$_2$, likely due to the surface chemistry of the particles and the presence/absence of surface hydroxyl groups. Electrophoretic mobility measurements and XAS analysis indicated that As (III) and As (V) form binuclear bidentate inner-sphere complexes with amorphous TiO$_2$. As (III) and As (V) sorption isotherms indicated that sorption capacities of the different TiO$_2$ polymorphs were dependent on the sorption site density, surface area (particle size) and crystalline structure. When surface coverages were normalized to specific surface areas, crystalline TiO$_2$ appeared to exhibit higher capacities. However, a reverse trend was observed when arsenic sorption was expressed on a per unit mass basis.