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① what are the mathematical symbols representing existential,
universal, and conditional characterizations.

$\exists$ - there exists

$\forall$ - for all

$\rightarrow$ - if-then

② Define a subset using symbols.

Given sets A and B.

$A \subseteq B \quad \forall x \mid x \in A \rightarrow x \in B$

③ Define a cartesian product using symbols.

Given sets A and B.

$A \times B = \{(a,b) \mid a \in A \wedge b \in B\}$

④ Define a function using symbols.

(A relation that satisfies the following 2 properties)

Given sets A and B.

① $\forall x : x \in A, \exists y : y \in B \mid (x,y) \in F.$

② $\forall x : x \in A, \forall y, z : y, z \in B, (x,y) \in F \wedge (x,z) \in F \rightarrow y = z.$

⑤ Does f = g? Explain.

$\forall x \in R, f(x), g(x) \in R \qquad\qquad f(x) = g(x) \leftrightarrow f = g$

$f(x) = 2x \quad \wedge \quad g(x) = \dfrac{2x^3 + 2x}{x^2 + 1}$

$g(x) = \dfrac{2x^3 + 2x}{x^2 + 1} \rightarrow \dfrac{2x(x^2 + 1)}{x^2 + 1} = 2x$

$f(x) = 2x$ and $g(x)$ simplifies to $2x$.

$\therefore \quad f(x) = g(x) \; \forall x \in R$, so $f = g$.

Since $2x = 2x \; \forall x \in R, \; f = g.$