Hello :)

Cs 456?

$1+1=2$
$2+2=4$ } axioms

$1+1+1+1=4$
$2+1+1=4$
$2+2=4$
$4=4$

$.\overline{999}=1$
$.\overline{333}=1/3$
$3(.\overline{333})=3(1/3)$
$.\overline{999}=3/3$

for all integers n;
if n^3+5 is odd, n is even

if n is even 2k
" " odd 2k+1
(integers)

$2k+1=n^3+5$
$=(2j+1)^3+5$
$=8j^3+3(2j)^2(1)+3(2j)(1)^2+1^3+5$
$2k=8j^3+12j^2+6j+5$
$k=4j^3+6j^2+3j+5/2$
$k-4j^3-6j^2-3j\neq 5/2$
thus n must be even ↯

Suppose $\sqrt{2}$ is rational
$\sqrt{2}=a/b$ ← integers
$\sqrt{2}\,b=a$
$2b^2=a^2$ $2m=a$
even
$2b^2=(2m)^2$
$2b^2=4m^2$
$b^2=2m^2$

if a and b are even
$\sqrt{2}=\frac{2a}{2b}$ since rational numbers can't have common factors
Contradiction $\sqrt{2}$ is irrational ↯

$\forall x, P(x)$ P even integer have form 2x
$\exists x, \neg P(x)$

if m and n are integers and mn odd, then m is odd and n is odd
" " then m is even or n is even

if m+n is irrational, either m or n is irrational
" both m and n are rational

Induction
Prove base case
Prove if true for x, then true for x+1

A binary tree is a tree in which no parent can have more than two children
Prove that a binary tree with height h has at most 2^h leaves

$L(h)\leq 2^h$
$L(0)=1=2^0$
$L(h+1)\leq 2^{h+1}$
$2L(h)\leq 2^{h+1}$
$2(2^h)\leq 2^{h+1}$
$2^{h+1}\leq 2^{h+1}$

0!
$n!=n(n-1)(n-2)\dots(3)(2)(1)$

Prove $2^n\leq n!$

$2^0=1\leq 0!=1$
$2^1=2\not\leq 1!=1$
$2^2=4$ $2!=2$
$2^3=8$ $3!=6$
$2^4=16\leq 4!=24$ ← base case
$2^5=32\leq 5!=120$

$2^n\leq n!$

$2^n\leq n!$
$(n+1)2^n\leq(n+1)n!$
$\leq(n+1)!$
$2(2^n)<(n+1)!$