

Math 3200 Exam 2
Thursday, October 23, 2003

Each problem is worth 25 points.

1. Let $f : \mathbb{R} \rightarrow \mathbb{R}$, $f(x) = x^3 - 3x$. Find $f_*([0, 2])$ and $f^*([0, 2])$.
2. Prove: For all functions $f : X \rightarrow Y$ and $g : Y \rightarrow Z$, if f is injective and g is injective, then $g \circ f$ is injective.
3. Determine if each of the following relations R on the set of real numbers is reflexive, symmetric, or transitive. Give a proof or a counterexample in each case.
 - (a) xRy if $xy > 0$.
 - (b) xRy if there exists $n \in \mathbb{Z}$ such that $x - y = n$.
4. Prove: For all integers a, b, c, d , and all natural numbers n , if $a \equiv b \pmod{n}$ and $c \equiv d \pmod{n}$, then $a + c \equiv b + d \pmod{n}$.