**2.3 Functions**

**Q15. Determine whether each of these functions is a bijection from R to R ?**

**a) *f (x)* = 2*x* + 1**

yes

**b) *f (x)* = + 1**

no

**c) *f (x)* =**

yes

**d) f (x) = ( + 1)/ ( + 2)**

no

**Q24. Let *f (x)* = *ax* + *b* and *g(x)* = *cx* + *d*, where *a, b, c*, and *d* are constants.**

**Determine necessary and sufficient conditions on the constants *a, b, c*, and *d* so that**

***f* ◦ *g* = *g* ◦ *f* ?**

Forming the compositions we have

(f **◦** g)(x) = acx + ad + b.

(g **◦** f)(x) = cax + cb + d.

These are equal if and only if ad + b = cb + d. which is the sufficient condition.

**Q34. Show that if *x* is a real number and *n* is an integer, then :**

**a) x ≤ n if and only if éxù ≤ n.**

The " if" direction is trivial, since x ≤ éxù.

For the other direction, suppose that x ≤ n. Since n is an integer greater or equal to x, and éxù is the smallest such integer, clearly éxù ≤ n.

**b) n ≤ x if and only if n ≤ ëxû .**

The " if " direction is trivial, since ëxû ≤ x.

For the other direction, suppose that n ≤ x. Since n is an integer smaller or equal to x, and ëxû is the largest such integer, clearly n ≤ ëxû.