f) the greatest lower bounds of b and c	
5. Classify each of the following as a total function, a partial function, or not a function. a) f = {(1, a)} for domain space {1} and range space {a, b}. b) f(x) = 1/x when both domain and range space are the Real numbers (R). c) f(x) = sin(x) when domain space is the Natural numbers (N, the positive integers) and range space is R. d) f(x) = $x^{½}$ when both domain and range space are R. (Recall that the square root of a positive number n is ⊕n.) e) f(x, y) = max(x, y) for domain space R ⊕ R and range space R. f) f = {((1, 1), a), ((2, 1), b), ((1, 2), b)} for domain space {1, 2} ⊕ {1, 2} and range space {a, b}. g) f = {((1, 1), a), ((1, 1), b), ((1, 2), b)} for domain space {1} ⊕ {1, 2} and range space {a, b}.	a) This is a function. Because every element of domain matches with range. And also function is defined for all domain. b) This is a partial function. Because f(x) does not have multiple values for a value of x. But also f(x) is not defined for all values of x, since 0 is a real number but does not have any reciprocal. c) It is a partial function. Because for a value of x, function f(x) does not have multiple values and it is not defined for all values of x. d) It is not a function. Because f(x) has more than one value for a single value of x. For example f(16) = +4 and -4. e) It is a function because f(x) is defined for all values of x and f(x) does not have more than one value for the same value of x. f) It is a partial function because here not all domains are used like <2,2> is not there and none used more than once. g) It is not a function because domain <1,1> is used more than once.
6. Using the functions f = {(a, 1), (b, 2), (c, 2), (d, 3)}, g = {(1, z), (2 ,z), (3, x)}, and h = {(1, a), (2, b), (3, c)}, give the following. (Assume that the domain and range spaces are the values shown.) a) f(b) b) g(f(d)) c) g restricted to the domain space {1, 2}	

d) $h \circ f$ e) h^{-1} f) $h^{-1}(h(2))$	
7. Classify each of the following functions as: injection, surjection, bijection, or none. Give the most specific answer. a) f ={(a, 1), (b, 2), (c, 2), (d, 3)} for domain space {a, b, c, d} and range space {1, 2, 3, 4} b) f ={(a, 1), (b, 2), (d, 3), (c, 5)} for domain space {a, b, c, d} and range space {1, 2, 3, 4, 5} c) f ={(a, 1), (b, 2), (c, 4), (d, 3)} for domain space {a, b, c, d} and range space {1, 2, 3, 4} d) f ={(a, 1), (b, 2), (c, 4), (d, 3), (e, 1)} for domain space {a, b, c, d, e} and range space {1, 2, 3, 4} e) f(x) = cos(x) when both domain and range space are R. f) f(x) = 3x+2 when both domain and range space are R. g) $f(x) = x^2+1$ when both domain and range space are positive R.	a) None: b,c have same image in range so not 1-1 and it's also empty so not on-to b) Injection: no two elements in domain have same image so 1-1 and it is empty so not on-to c) Bijection: it is 1-1 and on-to d) Surjection: e,a have same image so not 1-1 e) None: 0,2pi have same image so not 1-1. range(-1,1) and domain is R so not on-to f) Bijection: has a unique value for every x g) Injection: