

**SCHOOL OF APPLIED SCIENCE & HUMANITIES**  
**DEPARTMENT OF MATHEMATICS**

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**Unit 2: Functions**  
**Tutorial Answers**

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1. A function maps each element in the domain to exactly one element in the range.  
Example:  $f(x) = x^3 + 1$  is neither even nor odd.
2. Even, because  $f(-x) = |-x| = |x| = f(x)$ .
3.  $f(-2) = 3(-2) + 2 = -6 + 2 = -4$ .
4. If  $f(x_1) = f(x_2)$  implies  $x_1 = x_2$  for all  $x_1, x_2$  in the domain.
5. No, because  $f(2) = f(-2) = 4$ .
6. All real numbers except  $x = 3$ .
7. Range:  $[0, \infty)$ .
8.  $x + 4 > 0 \rightarrow x > -4$ .
9.  $-3 \leq x \leq 3$ .
10. Range:  $[-1, 1)$ .
11.  $(f \circ g)(x) = f(g(x)) = 2x^2 + 3$ .
12.  $(g \circ f)(x) = g(\sqrt{x}) = \sqrt{x} - 2$ .
13.  $(f \circ g)(2) = 1/(2 + 5) = 1/7$ .
14.  $(g \circ f)(x) = (3 - x)^2$ .
15. Not necessarily. In general,  $f \circ g \neq g \circ f$ .
16.  $f(x) = 2x^3 - x^2 + 5x - 7$ .
17.  $f(x) = 5^x$ .
18.  $f(x) = (x^2 + 1)/(x - 4)$ .
19.  $f(x) = \{x^2, x < 0; 2x + 1, x \geq 0\}$ .
20.  $f(x) = \sin(x)$ .
21. The inverse of  $f$ , denoted  $f^{-1}$ , is a function such that  $f(f^{-1}(x)) = x$ .
22.  $y = 2x + 5 \rightarrow x = (y - 5)/2 \rightarrow f^{-1}(x) = (x - 5)/2$ .
23. Yes, because it is strictly increasing on  $\mathbb{R}$ .
24.  $y = (x - 3)/(x + 2) \rightarrow xy + 2y = x - 3 \rightarrow xy - x = -3 - 2y \rightarrow x(y - 1) = -(3 + 2y) \rightarrow x = -(3 + 2y)/(y - 1)$ .
25.  $f(f^{-1}(x)) = e^{\ln(x)} = x$ , and  $f^{-1}(f(x)) = \ln(e^x) = x$ .
26.  $(x - 3)(x + 3)$ .

27.  $(x - 2)(x^2 + 2x + 4)$ .
28.  $(x + 2)(x + 3)$ .
29.  $(x + 3)(x^2 - 3x + 9)$ .
30.  $(x^2 - 4)(x^2 + 4) = (x - 2)(x + 2)(x^2 + 4)$ .
31.  $x = 2$  or  $x = 3$ .
32.  $x = (-3 \pm \sqrt{(9 + 16)})/4 = (-3 \pm 5)/4 \rightarrow x = 1/2$  or  $x = -2$ .
33.  $D = (-4)^2 - 4(1)(4) = 0$ , so one repeated real root.
34.  $x = (-1 \pm i\sqrt{3})/2$ .
35.  $x = 1/2$  (repeated root).
36.  $x > 3$ .
37.  $x \leq 2$ .
38.  $-5 < x - 2 < 5 \rightarrow -3 < x < 7$ .
39.  $x \geq 11$ .
40.  $-2x < 4 \rightarrow x > -2$ .
41. Because by definition, a function assigns exactly one output to each input.
42. No, by the vertical line test.
43.  $2 + 2 = 4$ .
44.  $x^3 - x = -x^3 + x \rightarrow 2x^3 - 2x = 0 \rightarrow 2x(x^2 - 1) = 0 \rightarrow x = 0, \pm 1$ .
45.  $(2 + 1/2) + (1/2 + 2) = 2.5 + 2.5 = 5$ .
46.  $\sqrt{x + 1} - \sqrt{x} = 1 \rightarrow \text{Let } \sqrt{x} = t \rightarrow \sqrt{t^2 + 1} - t = 1 \rightarrow \sqrt{t^2 + 1} = t + 1 \rightarrow t^2 + 1 = t^2 + 2t + 1 \rightarrow 2t = 0 \rightarrow t = 0 \rightarrow x = 0$ .
47. Inverse formula:  $f^{-1}(x) = (x - b)/a = 2x - 3 \rightarrow 1/a = 2 \rightarrow a = 1/2$ , and  $-b/a = -3 \rightarrow b = 3/2$ .
48. Not over  $\mathbb{R}$ , only over  $[0, \infty)$  because  $f$  is not one-to-one over  $\mathbb{R}$ .
49. Equal roots when  $k^2 - 16 = 0 \rightarrow k = \pm 4$ .
50.  $f(1) = 2 - 3 + 1 = 0$ ,  $f(-1) = 2 + 3 + 1 = 6 \rightarrow \text{sum} = 6$ .