

1. In the following questions,

$$f(x) = x^3 + 1 \quad \text{and} \quad g(x) = \frac{x}{x-6}.$$

- (a) Find $(f+g)(x)$, $(f-g)(x)$, $(f \cdot g)(x)$, and $(f/g)(x)$. (You need not simplify.)
- (b) Find $(f \circ g)(x)$ and $(g \circ f)(x)$. (You need not simplify.)
- (c) What is the domain of $(f \circ g)(x)$ and $(g \circ f)(x)$?

2. For the following problems, let

$$h(x) = x^4 + 5x^3 + x^2 - 21x - 18.$$

- (a) What is the domain of h ? What is the range of h ?
- (b) What is the degree of $h(x)$? What is the leading coefficient? What is the constant term?
- (c) What is the end behavior of $h(x)$ as $x \rightarrow \infty$ or $x \rightarrow -\infty$?
- (d) Use the Rational Zero (Root) Test to list all possible rational zeros of $h(x)$.
- (e) Factor $h(x)$ as completely as possible.
- (f) List all the zeros of $h(x)$ and state the multiplicity of each.
- (g) Sketch a graph of h .

3. In the following questions,

$$h(x) = x^4 + 5x^3 + x^2 - 21x - 18 \quad \text{and} \quad g(x) = \frac{x}{x-6}.$$

- (a) Calculate $(h+g)(1)$, $(h \cdot g)(1)$, $(h \circ g)(1)$, and $(g \circ h)(1)$.
[Hint: Do **not** find a formula first.]
- (b) What is the domain of the function $(x-6) \cdot g(x)$?

4. Let

$$k(x) = \sqrt{12-3x} \quad \text{and} \quad f(x) = x^2.$$

- (a) Find a formula for $(f \circ k)(x)$.
- (b) What is the domain of $(f \circ k)(x)$?

5. Let

$$k(x) = \sqrt{12-3x}.$$

- (a) Sketch the graph of $y = k(x)$. [Hint: Consider $x = 4$ and $x = 1$.]
- (b) What is the domain of k ? What is the range of k ?
- (c) Is k a one-to-one function? Why or why not?
- (d) Find a formula for $k^{-1}(x)$.
- (e) What is the domain of k^{-1} . (Be careful.)
- (f) Sketch the graph of $y = k^{-1}(x)$. [Hint: Consider $y = 4$ and $y = 1$.]
- (g) In what way are the hints in (a) and (f) related to each other?

6. Let

$$f(x) = \frac{x - 3}{x^2 + 3x - 10}.$$

- (a) What is the domain of f ?
 - (b) Find the vertical asymptotes of f , if there are any.
 - (c) Find the horizontal asymptotes of f , if there are any.
 - (d) Sketch the graph of f . Include any asymptotes as dotted lines.
7. The graph of $y = f(x)$ is given below. Use this to answer the following questions.
- (a) What is the domain of f ?
 - (b) What is the range of f ?
 - (c) Does f have any symmetry? If so, what type(s)?
 - (d) Is f an odd function? Is f an even function?
 - (e) Does f have an inverse? Why or why not?
 - (f) List the zeros of f .
 - (g) The function f is either a polynomial or a rational function. Which one is it, and why?
 - (h) The degree of $f(x)$ is either 4 or 5? Which one is it, and why?
 - (i) You are told to plot a new graph: $i(x) = f(2x)$. How do you do it?
 - (j) You are told to plot a new graph: $j(x) = f(x + 2)$. How do you do it?
 - (k) You are told to plot a new graph: $k(x) = f(x) - 3$. How do you do it?
 - (l) You are told to plot a new graph: $l(x) = 3f(x)$. How do you do it?
 - (m) You are told to plot a new graph: $m(x) = |f(x)|$. How do you do it?
 - (n) You are told to plot a new graph: $n(x) = f(x - 2) + 4$. How do you do it?
 - (o) You are told to plot a new graph: $o(x) = 2f(x) - 3$. How do you do it?

