

LESSON PLAN

Course: Grade 12 U Advanced Functions

Lesson: 2 - 10

Unit/Chapter: Functions

Topic: Unit Review

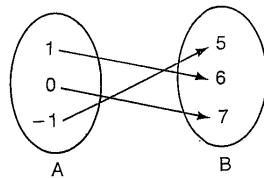
- ☐ *homework check:* collect unit assignments
- ☐ *unit review:* FM 12 p 211 exercise 6.10
Harcourt Mathematics 12 p 28 (chapter 1 review) and p. 67 (chpt 2)

6.10 REVIEW EXERCISE

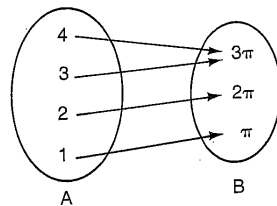
- A 1. If $f(x) = x^2 - 2$ and $g(x) = 2(x - 3)$, state.
- (a) $f(3)$ (b) $g(3)$ (c) $f(-4)$ (d) $g(8)$
 (e) $f(1)$ (f) $f(10)$ (g) $g(-2)$ (h) $g(0)$
 (i) $g(-3)$ (j) $f(0)$ (k) $f(-8)$ (l) $f(\pi)$

2. State the domain and range of the functions represented by the following arrow diagrams. Which of them are 1-1?

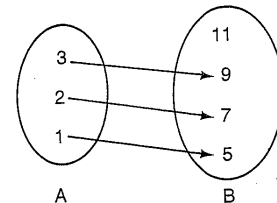
(a)



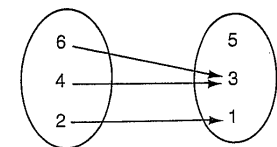
(b)



(c)

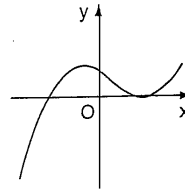


(d)

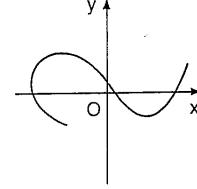


3. Which of the following figures are graphs of functions? Which of the functions are 1-1?

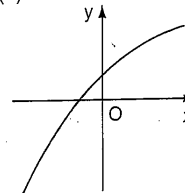
(a)



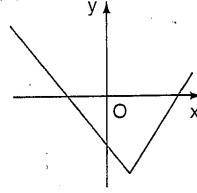
(b)



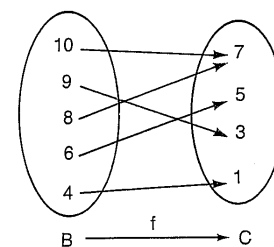
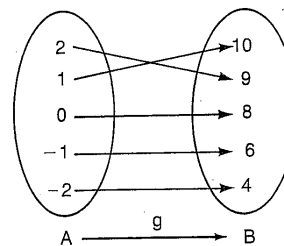
(c)



(d)



4. The functions f and g are defined by the following arrow diagrams.



State.

- (a) $f(g(-1))$ (b) $f(g(2))$
 (c) $f(g(1))$ (d) $f(g(0))$
 (e) $g^{-1}(9)$ (f) $g^{-1}(4)$
 (g) $g^{-1}(10)$ (h) $g(f(4))$

5. In each of the following cases describe how the graph of the given function can be obtained from the graph of f .

- (a) $y = f(x) - 4$ (b) $y = f(x - 4)$
 (c) $y = 3f(x)$ (d) $y = f(3x)$
 (e) $y = -f(x)$ (f) $y = 2f(x + 1)$
 (g) $y = f(x - 1) + 2$ (h) $y = \frac{1}{3}f(x) - 5$

B 6. Find the domain of each of the following functions.

- (a) $f(x) = \frac{1}{x^2 - 4}$ (b) $f(x) = \frac{1}{x^2 + 4}$
 (c) $f(x) = \sqrt{3 + x}$ (d) $f(x) = \sqrt[3]{3 + x}$

7. Draw the graphs of the following functions. Use transformations where appropriate.

- (a) $f(x) = 5 - 4x$ (b) $f(t) = (t - 1)^2 + 3$
 (c) $y = \sqrt{x}$ (d) $y = \sqrt{x - 3}$
 (e) $f(x) = x^4$ (f) $g(x) = (x + 2)^4 - 1$
 (g) $y = 3|x - 1|$ (h) $y = \frac{1}{x + 3}$

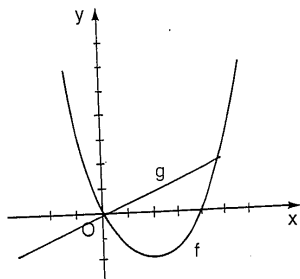
- (i) $y = \frac{1}{x^2}$ (j) $y = 1 - \frac{1}{x^2}$
 (k) $y = 1 - 4x - x^2$ (l) $y = 2x^2 + 4x + 5$

8. Determine whether each of the following functions is even, odd, or neither.

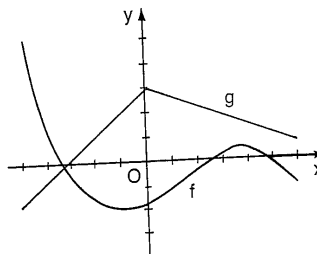
- (a) $f(x) = 2x^3 + x^5$ (b) $g(t) = t^2 + t^6$
 (c) $y = x^3 + 1$ (d) $y = \frac{2}{x^2 + 1}$

9. Copy the following graphs and use graphical addition to sketch the graph of $f + g$.

(a)



(b)



10. In each of the following cases find $f \circ g$, $g \circ f$, $f \circ f$, and $g \circ g$.

- (a) $f(x) = x^2$ $g(x) = x - 2$
 (b) $f(x) = x^2 + 1$ $g(x) = x^2 - 1$
 (c) $f(x) = \sqrt{x}$ $g(x) = x^2$
 (d) $f(x) = \frac{1}{x + 1}$ $g(x) = \frac{x}{x - 1}$

11. Which of the following functions are 1-1? Find the inverse of each function that is 1-1.

- (a) $y = 2x + 9$
 (b) $y = (x + 2)^2 + 3$
 (c) $y = \sqrt{x + 1}$
 (d) $y = 1 - x^3$
 (e) $y = 1 - x^4$
 (f) $y = (x + 2)^2, x \geq -2$
 (g) $y = \frac{x + 5}{x - 5}$
 (h) $y = \frac{1}{x^2}$

12. Graph the function f defined by

$$f(x) = \begin{cases} 2(1 - x) & \text{if } x < 0 \\ 2 + x & \text{if } x \geq 0 \end{cases}$$

C 13. Graph the function f defined by

$$f(x) = \begin{cases} 6(x + 2) & \text{if } -4 \leq x < -2 \\ 1 - (x + 1)^2 & \text{if } -2 \leq x < 0 \\ 1 - (x - 1)^2 & \text{if } 0 \leq x < 2 \\ 6(x - 2) & \text{if } 2 \leq x \leq 4 \end{cases}$$

- range of g : $\{y \mid 0 \leq y \leq 1\}$
 (b) $g \circ f$ not defined (range of f not contained in domain of g)
 $(f \circ g)(x) = 3 - x^2$ on domain of g : $\{x \mid -1 \leq x \leq 1\}$
 8. $f(x) = \sqrt{x}$, $g(x) = 8x^2 + x$
 9. $g(x) = 4x - 5$
 11. $g(x) = 4x - 17$
 12. (b) $(f \circ f)(x) = x + \frac{1}{x} + \frac{x}{x^2 + 1}$, $(f \circ f \circ f)(x) = x + \frac{1}{x} + \frac{x}{x^2 + 1} + \frac{x}{x^4 + 3x^2 + 1}$
 13. (a) $(f \circ g)(x) = \sin(5x)$, $(g \circ f)(x) = 5 \sin x$, $(f \circ f)(x) = \sin(\sin x)$, $(g \circ g)(x) = 25x$
 (b) $(f \circ g)(x) = \cos^2 x + 3$, $(g \circ f)(x) = \cos(x^2 + 3)$, $(f \circ f)(x) = x^4 + 6x^2 + 12$, $(g \circ g)(x) = \cos(\cos x)$
 14. (a) domain of f : $\{x \mid x \leq -\sqrt{2} \text{ or } x \geq \sqrt{2}\}$, range of f : $\{y \mid y \geq 0\}$
 domain of g : \mathbb{R} , range of g : $\{y \mid -1 \leq y \leq 1\}$
 (b) $f \circ g$ not defined (range of g not contained in domain of f)
 $(g \circ f)(x) = \sin(\sqrt{x^2 - 2})$ on domain of f : $\{x \mid x \leq -\sqrt{2} \text{ or } x \geq \sqrt{2}\}$

EXERCISE 6.8

1. (a) and (b) only
 5. (a) $f^{-1}(x) = \frac{2-x}{5}$ domain: \mathbb{R}
 range: \mathbb{R}
 (c) $f^{-1}(x) = \sqrt{x}$ domain: $\{x \mid x \geq 0\}$
 range: $\{y \mid y \geq 0\}$
 (e) $f^{-1}(x) = x^{\frac{1}{3}}$ domain: \mathbb{R}
 range: \mathbb{R}
 2. (b), (c), and (f) only
 (b) $f^{-1}(x) = \frac{x-6}{13}$ domain: \mathbb{R}
 range: \mathbb{R}
 (d) $f^{-1}(x) = \frac{1}{x}$ domain: $\{x \mid x \neq 0\}$
 range: $\{y \mid y \neq 0\}$
 (f) $f^{-1}(x) = \frac{x+2}{3}$ domain: $\{x \mid -2 \leq x \leq 10\}$
 range: $\{y \mid 0 \leq y \leq 4\}$
 3. (a), (c), (d), (g), (i), and (j) only
 6. (a) $y = 2x + 7$ (b) $y = -5x + 36$ (c) $y = \left(\frac{x+6}{5}\right)^{\frac{1}{3}}$ (d) $y = x^2, x \geq 0$
 (e) $y = x^2 + 3, x \geq 0$ (f) $y = \frac{1}{x-1}$ (g) $y = \frac{1}{x} - 1$ (h) $y = \frac{1-x}{1+x}$
 (i) $y = \frac{2x+1}{4-3x}$ (j) $y = \frac{\pi}{x+3}$ (k) $y = \sqrt[4]{x}, x \geq 0$ (l) $y = 1 + \sqrt{\frac{x}{3}}, x \geq 0$
 (m) $y = \sqrt{x^2 - 9}, x \geq 3$ (n) $y = \sqrt{25 - x^2}, 0 \leq x \leq 5$
 7. (a) $f^{-1}(x) = \frac{x+8}{5}$; $(f \circ f^{-1})(x) = x$, $(f^{-1} \circ f)(x) = x$
 (b) $f^{-1}(x) = x^2, x \geq 0$; $(f \circ f^{-1})(x) = x$, $(f^{-1} \circ f)(x) = x$
 8. (i) (c) $f^{-1}(x) = \frac{x-1}{2}$ (ii) (c) $f^{-1}(x) = \sqrt{x-2} (x \geq 2)$
 (iii) (c) $f^{-1}(x) = \sqrt[3]{x}$ (iv) (c) $f^{-1}(x) = -\frac{1}{x}$

EXERCISE 6.9

1. 9
 2. $f_n(x) = x^{2n+1}$
 3. $f_{47}(2) = \frac{46}{47}$
 4. 800
 5. 119
 6. 24
 7. 3

6.10 REVIEW EXERCISE

1. (a) 7 (b) 0 (c) 14 (d) 10 (e) -1 (f) 98
 (g) -10 (h) -6 (i) -12 (j) -2 (k) 62 (l) $\pi^2 - 2$
 2. (a) domain $\{-1, 0, 1\}$, range $\{5, 6, 7\}$, $1 - 1$
 (b) domain $\{1, 2, 3, 4\}$, range $\{\pi, 2\pi, 3\pi\}$, not $1 - 1$
 (c) domain $\{1, 2, 3\}$, range $\{5, 7, 9\}$, $1 - 1$
 (d) domain $\{2, 4, 6\}$, range $\{1, 3\}$, not $1 - 1$
 3. (a), (c), and (d) are graphs of functions and (c) is $1 - 1$.
 4. (a) 5 (b) 3 (c) 7 (d) 7
 (e) 2 (f) -2 (g) 1 (h) 10
 5. (a) translate f downward 4 units

- (b) translate f to the right 4 units
 (c) stretch f vertically by a factor of 3
 (d) shrink f horizontally by a factor of $\frac{1}{3}$
 (e) reflect f in the x -axis
 (f) translate f to the left 1 unit and stretch vertically by a factor of 2
 (g) translate f to the right 1 unit and translate upward 2 units
 (h) shrink f vertically by a factor of $\frac{1}{3}$ and translate downward by 5 units
6. (a) $\{x \mid x \neq \pm 2\}$ (b) R (c) $\{x \mid x \geq -3\}$ (d) R
 8. (a) odd (b) even (c) neither (d) even
10. (a) $(f \circ g)(x) = x^2 - 4x + 4$, $(g \circ f)(x) = x^2 - 2$
 $(f \circ f)(x) = x^4$, $(g \circ g)(x) = x - 4$
 (b) $(f \circ g)(x) = x^4 - 2x^2 + 2$, $(g \circ f)(x) = x^4 + 2x^2$
 $(f \circ f)(x) = x^4 + 2x^2 + 2$, $(g \circ g)(x) = x^4 - 2x^2$
 (c) $(f \circ g)(x) = |x|$, $(g \circ f)(x) = x$
 $(f \circ f)(x) = x^{\frac{1}{4}}$, $(g \circ g)(x) = x^4$
 (d) $(f \circ g)(x) = \frac{x-1}{2x-1}$, $(g \circ f)(x) = -\frac{1}{x}$
 $(f \circ f)(x) = \frac{x+1}{x+2}$, $(g \circ g)(x) = x$
11. (a) $1-1, y = \frac{x-9}{2}$ (b) not $1-1$ (c) $1-1, y = x^2 - 1$
 (d) $1-1, y = (1-x)^{\frac{1}{3}}$ (e) not $1-1$ (f) $1-1, y = \sqrt{x} - 2, x \geq 0$
 (g) $1-1, y = \frac{5(x+1)}{x-1}$ (h) not $1-1$

6.11 CHAPTER 6 TEST

1. (b) and (c) are graphs of functions and (c) is $1-1$.
 2. $\{x \mid x > -1\}$ 4. $y = 2(x+3)^2 - 3$
 5. stretch vertically by factor of 2 and reflect in x -axis
 6. (a) neither (b) even (c) odd
 7. $(f \circ g)(x) = 27x^2 - 24x + 4$, $(g \circ f)(x) = -9x^2 - 6x + 4$
 8. $y = x^2 - 5, x \geq 0$
 9. (a) \$5.40
 (b) $C(x) = \begin{cases} 1.00, 0 < x \leq 0.2 \\ 1.00 + (0.10)k, \text{ where } 0.2 + (0.1)k < x \leq 0.3 + (0.1)k \text{ for } k = 0, 1, 2, \dots \end{cases}$

REVIEW AND PREVIEW TO CHAPTER 7

LAWS OF EXPONENTS

1. (a) 2^5 (b) 2^{15} (c) 2^8 (d) 2^{-1} (e) $2^{\frac{1}{2}}$ (f) $2^{\frac{3}{2}}$
 (g) 2^0 (h) 2^{12} (i) 2^5 (j) 2^{-3} (k) 2^{-1} (l) 2^6
 2. (a) 1 (b) $\frac{1}{3}$ (c) $\frac{1}{36}$ (d) 3 (e) 2 (f) 7
 (g) 27 (h) $\frac{1}{4}$ (i) $\frac{1}{64}$ (j) 1 (k) $\frac{1}{4}$ (l) 125
 3. (a) $8^9 \times 17^9$ (b) 45^8 (c) $\sqrt[3]{4}$ (d) $\sqrt[4]{7^3}$ or $(\sqrt[4]{7})^3$
 (e) $\frac{3^8}{17^8}$ (f) 4^6 (g) $x^{\frac{2}{3}}$ (h) π^8
 (i) 5^{13} (j) $3^{\frac{8}{3}}$ (k) $2^4 x^8$ (l) $5^{\frac{2}{3}}$
 (m) x^{5n} (n) x^{5+n} (o) $\frac{x^4}{2^4}$ (p) $3^{1.5}$
 (q) $5^{\frac{5}{2}}$ (r) x^{a+b+c} (s) 6^3 (t) x^{n+3}
 4. (a) 25 (b) x^5 (c) $\frac{1}{36}$ (d) $a^{4n} n^2$ (e) $-27x^{14}y^2$

Review Exercise

1. Draw a sketch of each of the following without using your graphing calculator.

a. $y = (x - 2)(x + 3)$

b. $y = -(x + 3)^2 + 1$

c. $y = x(x - 1)(x - 3)$

d. $y = (x + 2)(x - 4)(x - 2)$

e. $y = -(x - 2)^3$

f. $y = -(x + 4)(x - 1)(x + 3)$

g. $y = (x + 2)^2(x - 4)$

h. $y = (x - 2)^2(x + 1)^2$

i. $y = -x^2(x - 3)(x + 2)$

j. $y = (x - 4)(x + 1)(x + 2)(x - 3)$

k. $y = (x - 2)^3(x + 3)$

l. $y = -x(x + 2)(x - 3)$

2. In each of the following, you are given a set of points that lie on the graph of a polynomial function. If possible, determine the equation of the function.

a. $(-1, -27), (0, -11), (1, -5), (2, -3), (3, 1), (4, 13)$

b. $(0, 4), (1, 15), (2, 32), (3, 67), (4, 132), (5, 239)$

c. $(1, -9), (2, -31), (3, -31), (4, 51), (5, 299), (6, 821)$

d. $(1, 1), (2, 2), (3, 5), (4, 16)$

e. $(-2, 75), (-1, -11), (0, -21), (1, -27), (2, -53)$

3. Perform the following divisions:

a. $(x^3 - 2x^2 + 3x - 1) \div (x - 3)$

b. $(2x^3 + 5x + 4) \div (x + 2)$

c. $(4x^3 + 8x^2 - x + 1) \div (2x + 1)$

d. $(x^4 - 4x^3 + 3x^2 - 3) \div (x^2 + x - 2)$

4. Without using long division, determine the remainder when

a. $(x^2 - x + 1)$ is divided by $(x - 2)$.

b. $(x^3 + 4x^2 - 2)$ is divided by $(x + 1)$.

c. $(x^3 - 5x^2 + 2x - 1)$ is divided by $(x + 2)$.

d. $(x^4 - 3x^2 + 2x + 3)$ is divided by $(x + 1)$.

e. $(3x^3 + x + 2)$ is divided by $(3x - 1)$.

5. Divide each polynomial by the factor given, then express each polynomial in factored form.

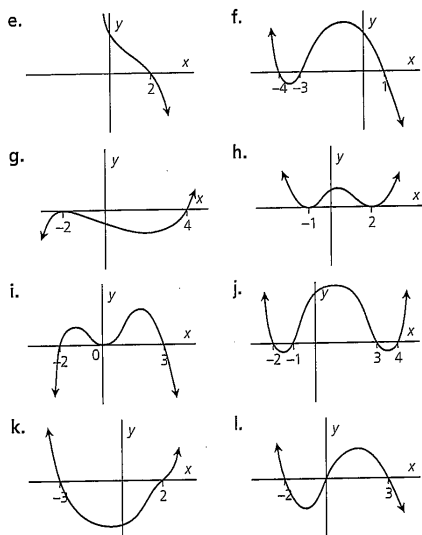
a. $x^3 + 2x^2 - x - 2$, given $x - 1$ is a factor.

b. $x^3 - 3x^2 - x + 3$, given $x - 3$ is a factor.

c. $6x^3 + 31x^2 + 25x - 12$, given $2x + 3$ is a factor.

6. a. When $x^3 - 3kx^2 + x + 5$ is divided by $x - 2$, the remainder is 9.
Find the value of k .

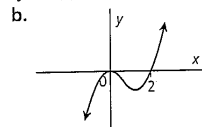
b. When $rx^3 + gx^2 + 4x + 1$ is divided by $x - 1$, the remainder is 12. When it is divided by $x + 3$, the remainder is -20 . Find the values of r and g .



2. a. $f(x) = x^3 - 5x^2 + 10x - 11$
 b. $f(x) = 2x^3 - 3x^2 + 12x + 4$
 c. $f(x) = x^4 - 14x^2 + 5x - 1$
 d. not enough information given
 e. not enough information given
3. a. $x^3 - 2x^2 + 3x - 1 = (x-3)(x^2 + x + 6) + 17$
 b. $2x^3 + 5x + 4 = (x+2)(2x^2 - 4x + 13) - 22$
 c. $4x^3 + 8x^2 - x + 1 = (2x+1)(2x^2 + 3x - 2) + 3$
 d. $x^4 - 4x^3 + 3x^2 - 3 = (x^2 + x - 2)(x^2 - 5x + 10) - 20x + 17$
4. a. 3 b. 1 c. -33 d. -1 e. $\frac{22}{9}$
5. a. $x^3 + 2x^2 - x + 2 = (x-1)(x+1)(x+2)$
 b. $x^3 - 3x^2 - x + 3 = (x-3)(x-1)(x+1)$
 c. $6x^3 + 31x^2 + 25x - 12 = (2x+3)(3x-1)(x+4)$
6. a. $k = \frac{1}{2}$ b. $r = 2, g = 5$

Chapter 1 Test

1. a. $2(3x-56)(3x+56)$ b. $(pm+1)(m^2+1)$
 c. $2(3x-2)(2x-3)$ d. $(x+y-3)(x-y+3)$
2. a.

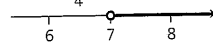


3. a. $q(x) = x^2 - 7x + 20$ $r(x) = -44$
 b. $q(x) = x^2 + 3x + 3$ $r(x) = 11$
4. Yes.
5. -40
6. $k = 3$
7. a. Yes. b. $f(x) = 2x^3 - 3x^2 + 5x - 8$
8. $c = \frac{-14}{3}, d = -\frac{5}{3}$
9. $(x-3)(x+3)$

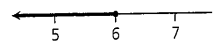
CHAPTER 2 POLYNOMIAL EQUATIONS AND INEQUALITIES

Review of Prerequisite Skills

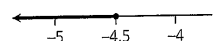
1. a. -3 b. no solution c. $\frac{11}{4}$ or 2.75 d. 1
2. a. $x > 7$



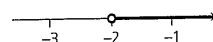
b. $x \leq 6$



c. $x \leq -4.5$



d. $x > -2$



3. a. 0 b. 15 c. 10 d. 0
4. a. -2 b. 13 c. -52 d. $\frac{53}{8}$
5. a. $(x-6)(x-8)$ b. $(y-2)(y-1)$ c. $(3x-7)(x-1)$
 d. $3(x-5)(x+5)$ e. $(3x-1)(2x+3)$ f. $x(x+8)(x-7)$
 g. $4x(x+5)$ h. $3x(x-2)(x+2)$ i. $2(3x+2)(x-3)$
6. a. 0, 4 b. 3, -2 c. -3, -2 d. -6, -3 e. 5, -3 f. -1, $\frac{4}{7}$
 g. $1, \frac{7}{3}$ h. -3, 0, 3 i. $\frac{1}{3}, 4$
7. a. 1.5, -5.5 b. 2.3, -0.6 c. $\frac{-1 \pm \sqrt{35}}{6}$ d. 5.7, -0.7
 e. 3, -0.5 f. 1.5, -0.7 g. $\frac{3 \pm \sqrt{31}}{4}$ h. -6, 1 i. 8.3, 0.7

Exercise 2.1

1. 0
2. a. $(x-5)$ b. Divide.
3. $(x+1), (x-2), (x+3)$
4. a. Yes. b. No. c. Yes. d. No. e. No. f. Yes.
5. b. $x-3$ c. $x^2 + x + 1$
6. b. $x+2$ c. $x^2 - 4x + 3$
7. a. $(x-1)(x^2 + x - 3)$ b. $(x+2)(x-1)(x+1)$
 c. $(y-1)(y^2 + 20y + 1)$ d. $(x+1)(x^2 + x + 4)$
 e. $(y-2)(y^2 + y + 1)$ f. $(x-4)(x^2 - 5x + 2)$
 g. $(x+2)(x-3)(x^2 - 7x + 2)$ h. $(x+2)(x-8)(x^2 + 1)$
8. 2.5
9. 1.5
10. a. $(x-3)(x^2 + 3x + 9)$ b. $(y+2)(y^2 - 2y + 4)$
 c. $(5u-4r)(25u^2 + 20ur + 16r^2)$
 d. $2(10w+y)(100w-10wy+y^2)$
 e. $(x+y-uz)(x^2 + 2xy + y^2 + xuz + yuz + u^2z^2)$
 f. $(5)(u-4x-2y)(u^2 + 4ux + 2uy + 16x^2 + 16xy + 4y^2)$
11. b. $x^3 + x^2y + xy^2 + y^3$ c. $(x-3)(x^3 + 3x^2 + 9x + 27)$
12. b. $x^4 + x^3y + x^2y^2 + xy^3 + y^4$
13. b. $(x-2)(x^4 - 2x^3 + 4x^2 - 8x + 16)$
14. b. $x^{n-1} + x^{n-2}y + x^{n-3}y^2 + \dots + y^{n-1}$
17. If n is odd.
18. $(x+y)(x^4 - x^3y + x^2y^2 - xy^3 + y^4)$
19. No.

Exercise 2.2

1. a. $\pm \frac{1}{2}, \pm \frac{5}{2}, \pm 1, \pm 5$ b. $-\frac{1}{3}, \frac{2}{3}$ c. $\pm 1, \pm 2, \pm \frac{1}{2}, \pm \frac{1}{4}$
 d. $\pm 1, \pm 2, \pm 4, \pm \frac{1}{2}, \pm \frac{1}{4}, \pm \frac{1}{8}$ e. $\pm 1, \pm 3, \pm \frac{1}{2}, \pm \frac{3}{2}, \pm \frac{1}{3}, \pm \frac{1}{6}$ f. $\pm 1, \pm 2, \pm 3, \pm 6, \pm \frac{1}{2}, \pm \frac{3}{2}$
2. $5(2x-3)(x-2)$
3. $-2(x-3)(4x+3)(x+2)$

Review Exercise

1. a. If $f(-3) = 0$, state a factor of $f(x)$.
b. If $f\left(\frac{2}{3}\right) = 0$, find a factor of $f(x)$, with integral coefficients.
2. a. Find the family of cubic functions whose x -intercepts are 4, 1, and -2 .
b. Find the particular member of the above family whose graph passes through the point (3, 10).
3. a. Determine if $x + 2$ is a factor of $x^5 - 4x^3 + x^2 - 3$.
b. Determine if $x - 3$ is a factor of $x^3 + x^2 - 11x - 3$.
4. Use the Factor Theorem to factor $x^3 - 6x^2 + 6x - 5$.
5. a. If $x - 1$ is a factor of $x^3 - 3x^2 + 4kx - 1$, what is the value of k ?
b. If $x + 3$ is a factor of $kx^3 + 4x^2 + 2kx - 1$, what is the value of k ?
6. Factor each of the following:
a. $x^3 - 2x^2 + 2x - 1$ b. $x^3 - 6x^2 + 11x - 6$
c. $8x^3 - 27y^3$ d. $3(x + 2w)^3 - 3p^3r^3$
7. Use the Factor Theorem to prove that $x^2 - 4x + 3$ is a factor of $x^5 - 5x^4 + 7x^3 - 2x^2 - 4x + 3$.
8. Use your graphing calculator to factor each of the following:
a. $2x^3 + 5x^2 + 5x + 3$ b. $9x^3 + 3x^2 - 17x + 5$
9. If $f(x) = 5x^4 - 2x^3 + 7x^2 - 4x + 8$,
a. is it possible that $f\left(\frac{5}{4}\right) = 0$? b. is it possible that $f\left(\frac{4}{5}\right) = 0$?
10. Factor fully:
a. $3x^3 - 4x^2 + 4x - 1$ b. $2x^3 + x^2 - 13x - 5$
c. $30x^3 - 31x^2 + 10x - 1$
11. Solve for x , $x \in C$.
a. $x^2 - 3x - 10 = 0$ b. $x^3 - 25x = 0$
c. $x^3 + 8 = 0$ d. $x^3 - x^2 - 9x + 9 = 0$
e. $x^4 - 12x^2 - 64 = 0$ f. $x^3 - 4x^2 + 3 = 0$

technology

- g. $x^3 - 3x^2 + 3x - 2 = 0$ h. $x^6 - 26x^3 - 27 = 0$
 i. $(x^2 + 2x)^2 - (x^2 + 2x) - 12 = 0$

12. Use your graphing calculator to find the approximate roots of the following equations (correct to three decimal places):

- a. $x^2 = 2$ b. $x^2 + 10x - 2 = 0$
 c. $x^3 - x^2 - 4x - 1 = 0$ d. $2x^3 + x^2 + 2 = 0$
 e. $x^4 - 10x^2 + 15 = 0$ f. $x^6 - 11x^5 + x^2 - 1 = 0$

13. If -2 is one root of $x^2 + kx - 6 = 0$, find the other root and the value of k .

14. Find the quadratic equation whose roots are the reciprocals of the roots of $2x^2 + 5x + 1 = 0$.

15. a. State the sum and product of the roots of $2x^2 - x + 4 = 0$.

b. Find a quadratic equation (with integral coefficients) whose roots have a sum of $\frac{1}{15}$ and a product of $-\frac{2}{15}$.

c. Find a quadratic equation (with integral coefficients) whose roots are $3 + 2i$ and $3 - 2i$.

d. If 2 is one root of the equation $3x^2 + 4kx - 4 = 0$, find the other root and the value of k .

e. Find an equation whose roots are each three less than the roots of $x^2 - 5x + 2 = 0$.

f. Find an equation whose roots are the reciprocals of the roots of $2x^2 + x - 4 = 0$.

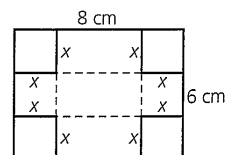
16. Solve for x , $x \in R$.

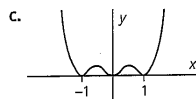
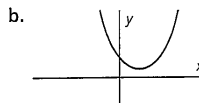
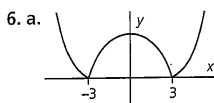
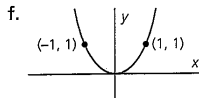
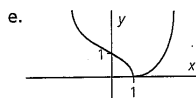
- a. $(x - 2)(x + 4) < 0$ b. $x^2 + x - 2 \geq 0$ c. $x^3 + 3x \leq 0$
 d. $x^3 - 2x^2 - x + 2 > 0$ e. $x^4 \leq 0$ f. $x^4 + 5x^2 + 2 \geq 0$
 g. $x^6 - 8x^4 + 2 < 0$ h. $x^9 - 2x^7 + 1 > 0$

17. Solve for x , $x \in R$.

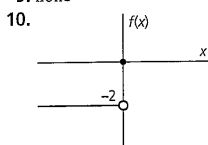
- a. $|3x - 1| = 11$ b. $|x + 1| < 3^{\frac{1}{10}}$ c. $|2x - 3| \geq 5$

18. Identical squares are cut from each corner of a rectangular sheet of tin $8 \text{ cm} \times 6 \text{ cm}$. The sides are bent upward to form an open box. If the volume of the box is 16 cm^3 , what is the length of each side of the squares cut from the original sheet?





7. a. $x = 4, -3$ b. $x = \frac{4}{3}, \frac{-8}{3}$ c. $-6 \leq x \leq 12$
 d. $x \geq 1$ or $x \leq -9$ e. $-\frac{1}{2} < x < \frac{7}{2}$ f. no solution
 8. a. -1 b. 0.8 c. $4, \frac{4}{3}$ d. $x > \frac{1}{2}$ e. $x < \frac{2}{5}$
 f. $x \leq -1$ or $x \geq \frac{5}{3}$ g. $-2, 4$ h. 0
 9. none



Review Exercise

1. a. $(x + 3)$ b. $(3x - 2)$
2. a. $y = a(x - 4)(x - 1)(x + 2)$ b. $y = -(x - 4)(x - 1)(x + 2)$
3. a. No. b. Yes.
4. $(x - 5)(x^2 - x + 1)$
5. a. $\frac{3}{4}$ b. $\frac{35}{33}$
6. a. $(x - 1)(x^2 - x + 1)$
 b. $(x - 1)(x - 2)(x - 3)$ c. $(2x - 3y)(4x^2 + 6xy + 9y^2)$
 d. $3(x + 2x - pr)(x^2 + 4xw + 4w^2 + prx + 2wpr + p^2r^2)$
8. a. $(2x + 3)(x^2 + x + 1)$ b. $(x - 1)(3x + 5)(3x - 1)$
9. a. Yes b. No
10. a. $(3x - 1)(x^2 - x + 1)$ b. $(2x - 5)(x^2 + 3x + 1)$
 c. $(5x - 1)(3x - 1)(2x - 1)$
11. a. -2.5 b. $0, -5, 5$ c. $-2, 1 \pm i\sqrt{3}$ d. $1, 3, -3$
 e. $-4, 4, \pm 2i$ f. $1, \frac{3 \pm \sqrt{21}}{2}$ g. $2, \frac{1 \pm i\sqrt{3}}{2}$
 h. $-1, 3, \frac{-3 \pm 3i\sqrt{3}}{2}, \frac{1 \pm i\sqrt{3}}{2}$ i. $-1 \pm \sqrt{5}, -1 \pm i\sqrt{2}$
12. a. $x \approx \pm 1.414$ b. $x \approx -10.196, 0.196$
 c. $x \approx -1.377, -0.274, 2.651$ d. $x \approx -1.197$
 e. $x \approx \pm 2.857, \pm 1.356$ f. $x \approx -5.67$
13. $x_2 = 3$ and $k = -1$
14. $x^2 + 5x + 2 = 0$
15. a. $x_1 + x_2 = \frac{1}{2}, x_1x_2 = 2$ b. $15x^2 - x - 2 = 0$
 c. $x^2 - 6x + 13 = 0$ d. $x_2 = -\frac{2}{3}, k = -1$
 e. $x^2 + x - 4 = 0$ f. $4x^2 - x - 2 = 0$
16. a. $-4 < x < 2$ b. $x \leq -2$ or $x \geq 1$ c. $x \leq 0$
 d. $-1 < x < 1$ or $x > 2$ e. $x = 0$ f. R

g. $-2.8 < x < -0.72$ or $0.72 < x < 2.8$

h. $-1.44 < x < 1$ or $x > 1.38$

17. a. $\frac{-10}{3}, 4$ b. $-4 < x < 2$ c. $x \leq -1$ or $x \geq 4$

18. 5 cm

Chapter 2 Test

1. No.
2. a. $(x - 1)(x^2 + 4x + 2)$ b. $(x + 1)(2x - 3)(x - 3)$
 c. $(x + 1)(x - 1)^3$
3. $(3x - 2)(x^2 + 2x + 2)$
4. a. $3, \frac{-3 \pm 3i\sqrt{3}}{2}$ b. $1, \frac{3 \pm i\sqrt{3}}{2}$ c. $0, \frac{1}{2}, 3$ d. $\pm 2, \pm 1$
5. $x^2 - 8x + 20 = 0$
6. Yes.
7. a. $-2 < x < 3$ or $x < -2$ b. $-2 \leq x \leq 0$ or $x \geq 2$
 c. $x < -7$ or $x > 2$
8. a. 3 zeros, positive, cubic (3rd)
 b. 2 zeros, positive, quartic (4th)
 c. 3 zeros, negative, cubic (3rd)
9. a. 173.9 cm b. 6.52 kg

CHAPTER 3 INTRODUCTION TO CALCULUS

Review of Prerequisite Skills

1. a. -3 b. -2 c. 12 d. -1 e. $\frac{-2}{3}$ f. $\frac{-2}{3}$ g. 4 h. -4 i. -1
 j. -1 k. $-\frac{41}{10}$ l. -1
2. a. $y = 4x - 2$ b. $y = -2x + 5$
 c. $y + 5 = 0$ d. $2x - 3y + 12 = 0$ e. $6x - 5y + 36 = 0$
 f. $x + y - 2 = 0$ g. $6x - y + 2 = 0$ h. $4x - y = 0$
 i. $7x - y - 27 = 0$ j. $3x + y - 6 = 0$ k. $x + 3 = 0$
 l. $y - 5 = 0$
3. a. $\frac{-5}{52}$ b. $\frac{-3}{13}$ c. 0 d. $\frac{5}{52}$
4. a. 6 b. $\sqrt{3}$ c. 9
5. a. $\frac{-1}{2}$ b. -1 c. 5 d. 1 e. 10^6
6. a. $\frac{5\sqrt{2}}{2}$ b. $\frac{6\sqrt{3} + \sqrt{6}}{3}$ c. $\frac{6 + 4\sqrt{3}}{3}$ d. $\frac{3 - \sqrt{3}}{6}$
 e. $\frac{-5\sqrt{7} - 20}{9}$ f. $-6 - 4\sqrt{3}$ g. $\frac{-15 + 10\sqrt{3}}{2}$
 h. $\frac{-6\sqrt{6} - 15\sqrt{2}}{13}$ i. $\frac{20 + 2\sqrt{5}}{19}$
7. a. $\frac{2}{5\sqrt{2}}$ b. $\frac{3}{6\sqrt{3} + \sqrt{6}}$ c. $\frac{-9}{5\sqrt{7} + 4}$ d. $\frac{-13}{6\sqrt{6} + 15\sqrt{2}}$
 e. $\frac{-1}{\sqrt{3} + \sqrt{7}}$ f. $\frac{1}{2\sqrt{3} - 7}$
8. a. $(x - 2)(x + 2)$ b. $x(x - 1)(x + 1)$ c. $(x + 3)(x - 2)$
 d. $(2x - 3)(x - 2)$ e. $x(x + 1)(x + 1)$ f. $(x + 2)(x^2 - 2x)$
 g. $(3x - 4)(9x^2 + 12x + 16)$ h. $(x - 2)(x^2 + 3)$
 i. $(x - 1)(x + 2)(2x - 3)$
9. a. $x \in R$ b. $x \in R$ c. $x \geq -5, x \in R$ d. $x \in R$
 e. $x \neq 1, x \in R$ f. $x \in R$ g. $x \geq 9, x \in R$ h. $x \neq 0, x \in R$
 i. $x \neq 5, x \in R$ j. $x \neq 4, -1, -5, x \in R$ k. $x \neq 3, \frac{1}{2}, x \in R$
 l. $x \neq -2, 1, -5, x \in R$

Exercise 3.1

1. a. 3 b. $\frac{-5}{3}$ c. $\frac{-1}{3}$
2. a. $\frac{-1}{3}$ b. $\frac{-7}{13}$

ANS