

*Solutions Manual for Precalculus with
Limits 6th Edition by Larson*

ISBN: 9798214407760

Solution and Answer Guide

LARSON, PRECALCULUS 2027, 9798214407050;

APPENDIX A: REVIEW OF FUNDAMENTAL CONCEPTS OF ALGEBRA

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APPENDIX A.1 REAL NUMBERS AND THEIR PROPERTIES

A.1.1.

irrational

A.1.2.

Origin

A.1.3.

terms

A.1.4.

Zero-Factor Property

A.1.5.

Yes. $|3 - 10| = |-7| = 7$ and $|10 - 3| = |7| = 7$.

A.1.6.

- (a) iii
- (b) iv
- (c) ii
- (d) v
- (e) i

A.1.7.

$-9, -\frac{7}{2}, 5, \frac{2}{3}, \sqrt{3}, 0, 3, -4, 2, -11$

- (a) Natural numbers: 5, 8, 2
- (b) Whole numbers: 5, 0, 8, 2
- (c) Integers: $-9, 5, 0, 8, -4, 2, -11$
- (d) Rational numbers: $-9, -\frac{7}{2}, 5, \frac{2}{3}, 0, 8, -4, 2, -11$
- (e) Irrational numbers: $\sqrt{3}$

A.1.8.

$\sqrt{5}, -7, -\frac{7}{3}, 0, 3.14, \frac{5}{4}, -3, 12, 5$

- (a) Natural numbers: 12, 5
- (b) Whole numbers: 0, 12, 5
- (c) Integers: $-7, 0, -3, 12, 5$
- (d) Rational numbers: $-7, -\frac{7}{3}, 0, 3.14, \frac{5}{4}, -3, 12, 5$
- (e) Irrational numbers: $\sqrt{5}$

A.1.9.

2.01, $0.\overline{6}$, -13 , $0.010110111\dots$, 1 , -6

(a) Natural numbers: 1

(b) Whole numbers: 1

(c) Integers: -13 , 1 , -6

(d) Rational numbers: 2.01 , $0.\overline{6}$, -13 , 1 , -6

(e) Irrational numbers: $0.010110111\dots$

A.1.10.

25 , -17 , $-\frac{12}{5}$, $\sqrt{9}$, 3.12 , $\frac{1}{2}\pi$, 18 , -11.1 , 13

(a) Natural numbers: 25 , $\sqrt{9} = 3$, 18 , 13

(b) Whole numbers: 25 , $\sqrt{9} = 3$, 18 , 13

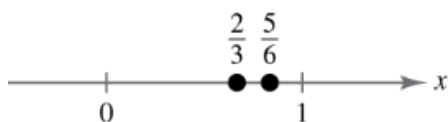
(c) Integers: 25 , -17 , $\sqrt{9} = 3$, 18 , 13

(d) Rational numbers: 25 , -17 , $-\frac{12}{5}$, $\sqrt{9} = 3$, 3.12 , 18 , -11.1 , 13

(e) Irrational numbers: $\frac{1}{2}\pi$

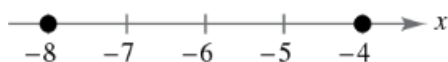
A.1.11.

$$\frac{5}{6} > \frac{2}{3}$$



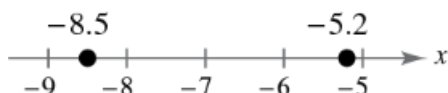
A.1.12.

$$-4 > -8$$



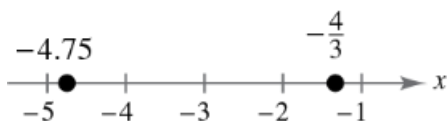
A.1.13.

$$-5.2 > -8.5$$



A.1.14.

$$-\frac{4}{3} > -4.75$$



A.1.15.

The inequality $x \leq 5$ denotes the set of all real numbers less than or equal to 5.

A.1.16.

The inequality $x < 0$ denotes the set of all real numbers less than zero.

A.1.17.

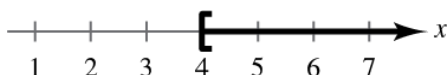
The inequality $-2 < x < 2$ denotes the set of all real numbers greater than -2 and less than 2 .

A.1.18.

The inequality $0 < x \leq 6$ denotes the set of all positive real numbers less than or equal to 6 .

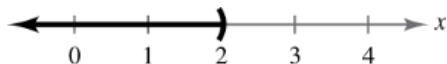
A.1.19.

The interval $[4, \infty)$ denotes the set of all real numbers greater than or equal to 4 ; $x \geq 4$.



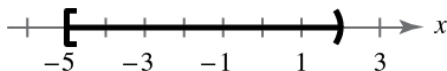
A.1.20.

The interval $(-\infty, 2)$ denotes the set of all real numbers less than 2 ; $x < 2$.



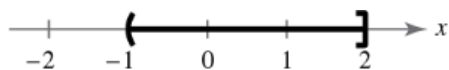
A.1.21.

The interval $[-5, 2)$ denotes the set of all real numbers greater than or equal to -5 and less than 2 ; $-5 \leq x < 2$.



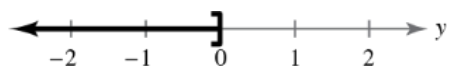
A.1.22.

The interval $(-1, 2]$ denotes the set of all real numbers greater than -1 and less than or equal to 2 ; $-1 < x \leq 2$.



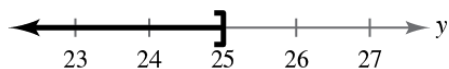
A.1.23.

$$(-\infty, 0]; y \leq 0$$



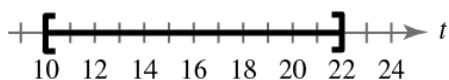
A.1.24.

$$(-\infty, 25]; y \leq 25$$



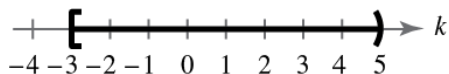
A.1.25.

$$[10, 22]; 10 \leq t \leq 22$$



A.1.26.

$$[-3, 5); -3 \leq k < 5$$



A.1.27.

$$|-10| = -(-10) = 10$$

A.1.28.

$$|0| = 0$$

A.1.29.

$$|-1| - |-2| = 1 - 2 = -1$$

A.1.30.

$$-3 - |-3| = -3 - (3) = -6$$

A.1.31.

$$5 |-5| = 5(5) = 25$$

A.1.32.

$$-4 |-4| = -4(4) = -16$$

A.1.33.

If $x < -2$, then $x + 2$ is negative.

$$\text{So, } \frac{|x+2|}{x+2} = \frac{-(x+2)}{x+2} = -1.$$

A.1.34.

If $x > 1$, then $x - 1$ is positive.

$$\text{So, } \frac{|x-1|}{x-1} = \frac{x-1}{x-1} = 1.$$

A.1.35.

$$|-4| = |4| \text{ because } |-4| = 4 \text{ and } |4| = 4.$$

A.1.36.

$$-5 = -|5| \text{ because } -5 = -5.$$

A.1.37.

$$-|-6| < |-6| \text{ because } |-6| = 6 \text{ and } -|-6| = -(6) = -6.$$

A.1.38.

$$-|-2| = -|2| \text{ because } -2 = -2.$$

A.1.39.

$$d(126, 75) = |75 - 126| = 51$$

A.1.40.

$$d(-20, 30) = |30 - (-20)| = |50| = 50$$

A.1.41.

$$d\left(-\frac{5}{2}, 0\right) = \left|0 - \left(-\frac{5}{2}\right)\right| = \frac{5}{2}$$

A.1.42.

$$d\left(-\frac{1}{4}, -\frac{11}{4}\right) = \left|-\frac{11}{4} - \left(-\frac{1}{4}\right)\right| = \left|-\frac{10}{4}\right| = \frac{5}{2}$$

A.1.43.

$7x + 4$
Terms: $7x$, 4
Coefficient: 7

A.1.44.

$6x^3 - 5x$
Terms: $6x^3$, $-5x$
Coefficients: 6 , -5

A.1.45.

$4x^3 + 0.5x - 5$
Terms: $4x^3$, $0.5x$, -5
Coefficients: 4 , 0.5

A.1.46.

$3\sqrt{3}x^2 + 1$
Terms: $3\sqrt{3}x^2$, 1
Coefficient: $3\sqrt{3}$

A.1.47.

Receipts: $R = \$3268.0$ billion
Expenditures: $E = \$3852.6$ billion
 $|R - E| = |3268.0 - 3852.6| = |-584.6| = \584.6 billion

A.1.48.

Receipts: $R = \$3329.9$ billion
Expenditures: $E = \$4109.0$ billion
 $|R - E| = |3329.9 - 4109.0| = |-779.1| = \779.1 billion

A.1.49.

Receipts: $R = \$3421.2$ billion
Expenditures: $E = \$6553.6$ billion
 $|R - E| = |3421.2 - 6553.6| = |-3132.4| = \3132.4 billion

A.1.50.

Receipts: $R = \$4897.3$ billion

Expenditures: $E = \$6273.3$ billion

$$|R - E| = |4897.3 - 6273.3| = |-1376.0| = \$1376.0 \text{ billion}$$

A.1.51.

$$x^2 - 3x + 2$$

$$(a) (0)^2 - 3(0) + 2 = 2$$

$$(b) (-1)^2 - 3(-1) + 2 = 1 + 3 + 2 = 6$$

A.1.52.

$$\frac{x-2}{x+2}$$

$$(a) \frac{2-2}{2+2} = \frac{0}{4} = 0$$

$$(b) \frac{-2-2}{-2+2} = \frac{-4}{0}$$

Division by zero is undefined.

A.1.53.

$$\frac{2x}{3} - \frac{x}{4} = \frac{8x}{12} - \frac{3x}{12} = \frac{5x}{12}$$

A.1.54.

$$\frac{3x}{4} + \frac{x}{5} = \frac{15x}{20} + \frac{4x}{20} = \frac{19x}{20}$$

A.1.55.

$$\frac{3x}{10} \cdot \frac{5}{6} = \frac{x}{2} \cdot \frac{1}{2} = \frac{x}{4}$$

A.1.56.

$$\frac{2x}{3} \div \frac{6}{7} = \frac{2x}{3} \cdot \frac{7}{6} = \frac{x}{3} \cdot \frac{7}{3} = \frac{7x}{9}$$

A.1.57.

False. Because zero is nonnegative but not positive, not every nonnegative number is positive.

A.1.58.

The product of two negative numbers is positive.

A.1.59.

The distributive law was used incorrectly. The 5 was not distributed to the 3.

A.1.60.

- (a) Because the price can only be a positive rational number with at most two decimal places, the description matches graph (ii).

A range of prices can only include zero and positive numbers with at most two decimal places. So, a range of prices can be represented by whole numbers and some noninteger positive fractions.

- (b) Because the distance is a positive real number, the description matches graph (i).

A range of lengths can only include positive numbers. So, a range of lengths can be represented by positive real numbers.

A.1.61.

$5/n$ increases or decreases without bound. As n approaches 0, $5/n$ increases when n is positive and decreases when n is negative.

A.1.62.

$5/n$ approaches 0 as n increases without bound. As n increases, $5/n$ decreases but stays positive.

A.1.63.

$$6 = 2 \cdot 3, 8 = 2 \cdot 2 \cdot 2$$

- (a) Greatest common factor: 2

- (b) Least common multiple: $2 \cdot 2 \cdot 2 \cdot 3 = 24$

A.1.64.

$$10 = 2 \cdot 5, 25 = 5 \cdot 5$$

- (a) Greatest common factor: 5

- (b) Least common multiple: $2 \cdot 5 \cdot 5 = 50$

A.1.65.

$$27 = 3 \cdot 3 \cdot 3, 36 = 2 \cdot 2 \cdot 3 \cdot 3, 54 = 2 \cdot 3 \cdot 3 \cdot 3$$

- (a) Greatest common factor: $3 \cdot 3 = 9$

- (b) Least common multiple: $2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 = 108$

A.1.66.

$$49 = 7 \cdot 7, 98 = 2 \cdot 7 \cdot 7, 112 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 7$$

- (a) Greatest common factor: 7

- (b) Least common multiple: $2 \cdot 2 \cdot 2 \cdot 2 \cdot 7 \cdot 7 = 784$

A.1.67.

$$-(3 \cdot 3) = -9$$

A.1.68.

$$(-3)(-3) = 3 \cdot 3 = 9$$

A.1.69.

$$\frac{(-5)(-5)}{-5} = -5$$

A.1.70.

$$\frac{-(5 \cdot 5)}{(-5)(-5)(-5)} = \frac{5 \cdot 5}{5 \cdot 5 \cdot 5} = \frac{1}{5}$$

A.1.71.

$$48 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 = 2^4 \cdot 3$$

A.1.72.

$$250 = 2 \cdot 5 \cdot 5 \cdot 5 = 2 \cdot 5^3$$

A.1.73.

$$792 = 8 \cdot 9 \cdot 11 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 11 = 2^3 \cdot 3^2 \cdot 11$$

A.1.74.

$$4802 = 2 \cdot 7 \cdot 7 \cdot 7 \cdot 7 = 2 \cdot 7^4$$

A.1.75.

$$3.785(10,000) = 37,850$$

A.1.76.

$$1.42(1,000,000) = 1,420,000$$

A.1.77.

$$\frac{6.09}{1000} = 0.00609$$

A.1.78.

$$\frac{8.603}{100,000} = 0.00008603$$

APPENDIX A.2 EXPONENTS AND RADICALS

A.2.1.

exponent; base

A.2.2.

index; radicand

A.2.3.

An expression involving radicals is in simplest form when the following conditions are satisfied:

1. All possible factors have been removed from the radical.
2. All fractions have radical-free denominators.
3. The index of the radical is reduced.

A.2.4.

64 is both a perfect square ($8^2 = 64$) and a perfect cube ($4^3 = 64$).

A.2.5.

$$5 \cdot 5^3 = 5^4 = 625$$

A.2.6.

$$\begin{aligned} (2^3 \cdot 3^2)^2 &= 2^{3 \cdot 2} \cdot 3^{2 \cdot 2} \\ &= 2^6 \cdot 3^4 = 64 \cdot 81 = 5184 \end{aligned}$$

A.2.7.

$$\frac{5^2}{5^4} = 5^{-2} = \frac{1}{5^2} = \frac{1}{25}$$

A.2.8.

$$\begin{aligned} \left(-\frac{3}{5}\right)^3 \left(\frac{5}{3}\right)^2 &= (-1)^3 \frac{3^3}{5^3} \cdot \frac{5^2}{3^2} = -1 \cdot 3^{3-2} \cdot 5^{2-3} \\ &= -3 \cdot 5^{-1} = -\frac{3}{5} \end{aligned}$$

A.2.9.

$$-3^2 = -9$$

A.2.10.

$$(-4)^{-3} = \frac{1}{(-4)^3} = -\frac{1}{64}$$

A.2.11.

$$\frac{4 \cdot 3^{-2}}{2^{-2} \cdot 3^{-1}} = 4 \cdot 2^2 \cdot 3^{-2-(-1)} = 4 \cdot 4 \cdot 3^{-1} = \frac{16}{3}$$

A.2.12.

$$\frac{3}{3^{-4}} = 3 \cdot 3^4 = 3^5 = 243$$

A.2.13.

When $x = 2$,

$$-3x^3 = -3(2)^3 = -24.$$

A.2.14.

When $x = 4$,

$$7x^{-2} = 7(4)^{-2} = \frac{7}{4^2} = \frac{7}{16}.$$

A.2.15.

When $x = 0.1$,

$$6x^2 = 6(0.1)^2 = 6(0.01) = 0.06.$$

A.2.16.

When $x = -\frac{1}{3}$,

$$12(-x)^3 = 12\left(\frac{1}{3}\right)^3 = 12\left(\frac{1}{27}\right) = \frac{4}{9}.$$

A.2.17.

$$6y^2(2y^0)^2 = 6y^2(2 \cdot 1)^2 = 6y^2(4) = 24y^2$$

A.2.18.

$$\begin{aligned} (-z)^3(3z^4) &= (-1)^3(z^3)3z^4 \\ &= -1 \cdot 3 \cdot z^{3+4} = -3z^7 \end{aligned}$$

A.2.19.

$$\frac{7x^2}{x^3} = 7x^{2-3} = 7x^{-1} = \frac{7}{x}$$