GRADE 11

Mathematics

PRE-CALCULUS

B.C. EDITION

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Table of Contents
Mathematics 11 – Pre-Calculus

Unit 1 – Numbers and Radicals — **Page**

1.1 The Real Number System — 2
1.2 Powers and Roots of Numbers — 9
1.3 Ordering Radicals and Using a Calculator to Approximate Values — 13
1.4 Simplifying Radicals by Factoring — 17
1.5 Adding and Subtracting Radicals — 20
1.6 Multiplication and Division of Square Root Radicals — 24
1.7 Laws of Exponents for Rationals — 29
1.8 Applications of Rational Exponents — 34
Curricular Competencies — 38
Aboriginal Applications — 39

Unit 2 – Properties and Applications of Radicals

2.1 Writing Radicals in Simplest Form — 46
2.2 Product of a Binomial times a Binomial — 50
2.3 Conjugates of Binomials and Rationalizing Denominators — 53
2.4 Relationships between Roots, Absolute Values and Signs — 56
2.5 Solving Equations Involving Radicals — 58
2.6 Problems Involving Radical Equations — 63
Curricular Competencies — 69
Aboriginal Applications — 70

Unit 3 – Rational Expressions and Equations

3.1 Rational Expressions — 75
3.2 Adding and Subtracting Rational Expressions — 79
3.3 Multiplying and Dividing Rational Expressions — 81
3.4 Multiple Operations with Rational Expressions — 84
3.5 Rational Equations — 86
3.6 Solving Problems Involving Rational Equations — 89
Curricular Competencies — 94

Unit 4 – Trigonometry

4.1 Definition of Trig Functions and Angles in Standard Position — 97
4.2 Special Angles — 107
4.3 Law of Sines — 112
4.4 Law of Cosines — 117
4.5 Solving General Triangles — 121
Curricular Competencies — 127
Aboriginal Applications — 128

Unit 5 – Factoring Polynomials — **Page**

5.1 Review of Factoring in General — 134
5.2 Factoring $ax^2 + bx + c, a \neq 0$ — 139
5.3 Factoring $a^2x^2 - b^2y^2, a \neq 0, b \neq 0$ — 142
5.4 Factoring $a[f(x)]^2 + b(f(x)) + c, a \neq 0$ — 144
5.5 Factoring $a^2[f(x)]^2 - b^2[g(y)]^2$; $a \neq 0, b \neq 0$ — 146
5.6 Combination of Factoring — 148
Curricular Competencies — 150

Unit 6 – Relations and Quadratic Functions

6.1 Review of Relations and Functions — 153
6.2 Graphs of Quadratic Functions — 165
6.3 Transformations of Quadratic Functions — 178
Curricular Competencies — 183
Aboriginal Applications — 184

Unit 7 – Applications with Quadratic Functions

7.1 Completing the Square — 189
7.2 Maximum and Minimum Problems — 194
7.3 Solving Quadratic Equations — 199
- 7.3.1 Solving by graphing — 199
- 7.3.2 Solving by factoring — 204
- 7.3.3 Solving by completing the square — 208
- 7.3.4 The quadratic formula — 210

7.4 The Discriminant — 214
Curricular Competencies — 218
Aboriginal Applications — 219

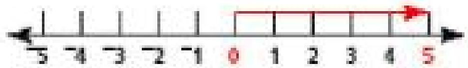
Unit 8 – Inequalities

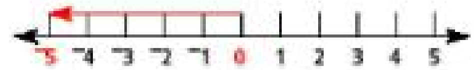
8.1 Graphing Inequalities in One Variable in Two Dimensions — 227
8.2 Graphing Inequalities in Two Variables — 230
8.3 Graphing Systems of Linear and Quadratic Inequalities — 236
8.4 Graphing Quadratic Inequalities in One Variable — 243
8.5 Problems for Quadratic Inequalities — 248
Curricular Competencies — 251
Aboriginal Applications — 252

Unit 9 – Financial Literacy

9.1 Simple and Compound Interest — 257
9.2 Using a Calculator — 260
9.3 Investments — 262
9.4 Investments with Regular Payments — 267
9.5 Loans with Regular and Single Payments — 270
9.6 Buying and Leasing — 274
Curricular Competencies — 278

Answers to Exercises and Tests — **282**





UNIT 1

NUMBERS AND RADICALS

1.1 The Real Number System

1.2 Powers and Roots of Numbers

1.3 Ordering Radicals and Using a Calculator to Find Approximate Values

1.4 Simplifying Radicals by Factoring

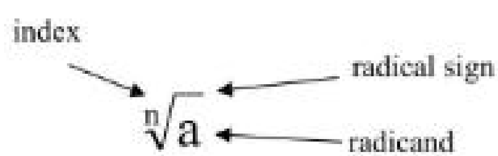
1.5 Adding and Subtracting Radicals

1.6 Multiplication and Division of Square Root Radicals

1.7 Laws of Exponents for Rationals

1.8 Applications of Rational Exponents

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



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1.1 The Real Number System

The system of **Real numbers** that we use in our everyday lives consists of a collection of smaller sets of numbers that has evolved over several centuries. It began with numbers used to count objects that were used for trading and other commercial purposes. It was extended and refined as a need for numbers to represent parts of objects and locations on the number line became important. Below is a discussion of the sets of numbers that comprise the Real Number System. Each of these sets of numbers builds on those contained in the preceding set.

Graphs of Real numbers can be associated with fixed points along the number line. Every point on the line corresponds to a number in the set of "Reals." All of these points on the line have tangible "real" values associated with them.

Composition of the Real Number System

The Real Number System is comprised of two major sets of numbers: **Rational numbers (Ra)** and **Irrational Numbers** (**Ir**).

Rational plus Irrational Numbers = Real Numbers

Rational numbers consist of all numbers that can be written in the form $\frac{a}{b}$, b $\neq 0$

Examples: $0.4 = \frac{2}{5}$, $-1\frac{1}{4} = -\frac{5}{4}$, $0 = \frac{0}{4}$

Irrational numbers consist of all other tangible numbers that cannot be written in that form.

Examples: ($\sqrt{3}$, $\sqrt{11}$, 1.2013772…).

Together, these sets of numbers make up the **Real Number** system.

Rational Numbers (Ra)

The Rational Number System can be broken down further to obtain the following:

Natural Numbers (N)

Natural numbers can be thought of as counting numbers. They can be used to identify how many objects are contained in a collection. Since a collection of objects has at least one item in it, the natural numbers begin with the number 1 and then proceed to represent additional objects in the set. Counting numbers can be listed as follows: 1, 2, 3, 4, 5, 6, 7, 8, …

Whole Numbers (W)

Whole numbers consist of the Natural numbers in addition to the number 0. Although 0 does not represent an object in a set, it is an important addition to the number system. Whole numbers can be listed as follows: 0, 1, 2, 3, 4, 5, 6, 7, 8, …

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Whole numbers correspond to locations on the number line as follows:

Integers (I)

The set of **Integers** builds on the set of Whole numbers by adding the negative values of each. As a result, it includes numbers such as -1, -2, -3, -4, -5, … Note that there is no negative value for 0. Negative values of Whole numbers are used in many situations, such as to represent a minus temperature (-22° C), distance below sea level (-8 m below the sea), or a golf score that is under par (-4 strokes under par).

Integers correspond to locations on the number line as follows:

Illustrating Real Numbers with a Venn Diagram

As shown in the Venn diagram below, the set of **Rational numbers** includes each of the following.

Natural Numbers: **N** = $\{1,2,3,4,.........\,..\}$

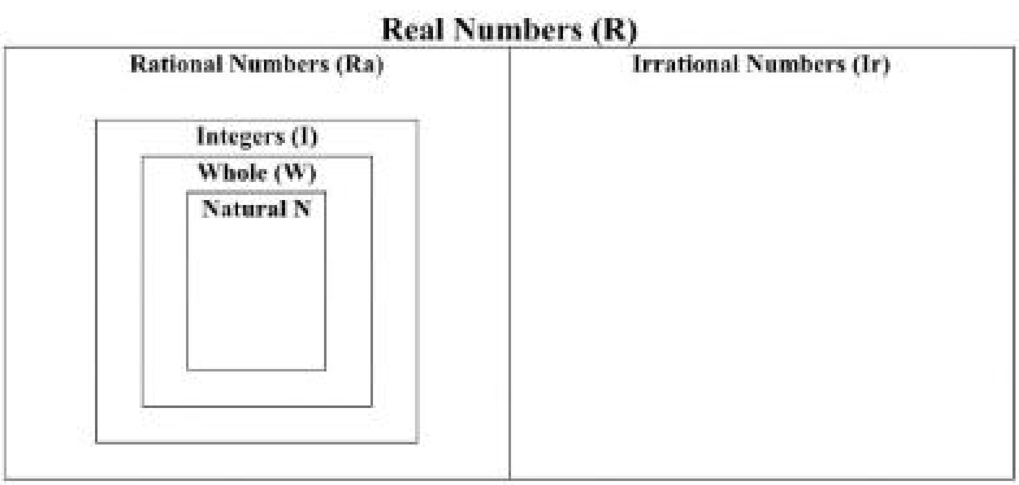
Whole Numbers: **W** = $\{0,1,2,3,4,.........\,..\}$

Integers: **I** = $\{......-3,-2,-1,0,1,2,3,4,........\}$

Rational: **Ra** = all of the above <u>plus</u> any other number that can be written in the form

$\frac{a}{b}$, b $\neq 0$ (Examples: 0.5, 1.24, $\frac{2}{5}$, $-1\frac{1}{4}$, 7)

All **Rational** and all **Irrational** numbers make up the set of **Real** numbers.



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Identification of Rational and Irrational Numbers

Recall that Rational numbers can be shown in several different formats, as long as they can be rewritten in the form $\frac{a}{b}$, $b \neq 0$.

1. Natural Numbers, Whole Numbers and Integers
   Examples: 7, -43, 0, 2761, - 403
2. Proper Fractions, Mixed Numbers, or Improper Fractions
   Examples: $\frac{3}{11}, -\frac{2}{9}, 3\frac{1}{4}, \frac{7}{5}, -8\frac{1}{10}, -\frac{7}{3}$
3. Decimals – terminating or repeating
   Examples: $0.8, -0.25, 0.223\,3\bar{3}, 2.61\,\overline{61}$

Irrational numbers cannot be shown as common fractions.

1. Decimals that do not terminate or repeat in a pattern (Example: 0.12323569…)
2. Roots of numbers that are not rational (Example: $\sqrt{2}, \sqrt{11}, -3\sqrt{5}, ..$)
3. Special numbers like π

Examples with Solutions

Identify which of the following are Rational and which are Irrational numbers. Give a reason for your answer.

Number	Rational or Irrational?	Reason
1. -1.75	Rational	It can be written as $-\frac{175}{100}$ or $-\frac{7}{4}$.
2. 0.4010347…	Irrational	The decimal doesn't terminate or repeat the same pattern.
3. $-\sqrt{36}$	Rational	It can be written as -6.
4. 0.2222 …	Rational	It repeats the same pattern and can be written as $\frac{2}{9}$.
5. $\sqrt{17}$	Irrational	The decimal version doesn't repeat the same pattern $\sqrt{17} = 4.123105626…$

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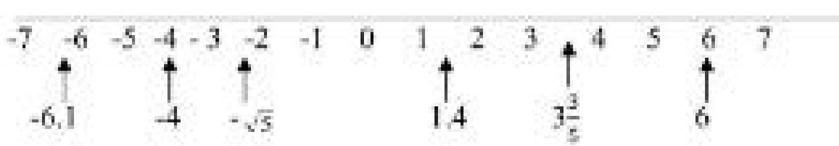
6. 5.01	Rational	It has a terminating decimal. It could be written as 5 $\frac{1}{100}$ or $\frac{501}{100}$.
7. $-9\frac{1}{2}$	Rational	It could be written as $-\frac{19}{2}$.
8. $3125\frac{1}{4}$	Rational	It could be written as $\frac{12501}{4}$.
9. 4.333….	Rational	The decimal repeats the same pattern and is equal to $4\frac{1}{3}$ or $\frac{13}{3}$.
10. 7.0100382…	Irrational	The decimal doesn't terminate or repeat the same pattern.

Comparing and Ordering Rational Numbers

Each rational number corresponds to a point on the number line.

Examples:



It should be noted that numbers **increase** in magnitude as you go from left to right on the line.

Examples: $1 < 3$, $2.1 < 4$; $-7 < -6$; and $2 > 1.8$; $-3 > -5$; $-1 > -10.5$

To compare the magnitudes of Rational numbers where one is written in decimal and the other in common fraction form, write both either in decimal or in common fraction form and then compare.

1. Compare 0.1 with $\frac{3}{40}$. Convert both to fractions first. Change 0.1 to $\frac{1}{10}$.

   The common denominator is 40, $\therefore$ $\frac{1}{10} = \frac{4}{40}$

   $\frac{4}{40} > \frac{3}{40}$ or $0.1 > \frac{3}{40}$

2. Compare 3.15 with $3\frac{2}{11}$. Convert both to decimals first. Change $3\frac{2}{11}$ to a decimal $\rightarrow 3.18\overline{18}$.

   $\therefore$ $3.15 < 3.18\overline{18}$

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Exercises 1.1

Identify each of the following as Rational or Irrational numbers. Give a reason for your answer.

	Rational or Irrational	Reason
1. 0.017		
2. $7\frac{1}{2}$		
3. 5.0900134...		
4. 0.3333....		
5. -19.001		
6. $\sqrt{64}$		
7. 0.144357...		
8. 0.313131...		
9. 510.013		
10. $\sqrt{6}$		
11. -5.666...		
12. 4.009		
13. $-343\frac{1}{3}$		

Use a check mark to indicate which set(s) each number belongs to.

		Set of Numbers				
	Number	N	W	I	Ra	Ir
14.	0.8					
15.	-35					
16.	$\frac{17}{7}$					
17.	0.15243...					

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	Number	N	W	I	Ra	Ir
18.	$0.\bar{7}$					
19.	3					
20.	$1\frac{3}{8}$					
21.	-155					
22.	0					
23.	$\sqrt{100}$					
24.	0.83					
25.	$\sqrt{20}$					

N = Natural Numbers, W = Whole Numbers, I = Integers, Ra = Rational Numbers, Ir = Irrational Numbers

26. Locate the following numbers on the number line.

$3.2,\ 2\frac{3}{8},\ -\frac{13}{12},\ -\sqrt{5},\ -\sqrt{16}$

-4 -3 -2 -1 0 1 2 3 4

27. Arrange the following numbers from smallest to largest.

a. –1.57, -0.517, -5.17, -5.71

b. $3.4,\ -\frac{11}{3},\ -3.4,\ -3.5$

c. $-\frac{3}{8},\ -\frac{2}{3},\ -0.6,\ -0.4$

28. Put the correct symbol (>, =, <) between each pair of numbers.

a. 0.16 $\frac{7}{40}$

b. -1.8 $-\frac{9}{5}$

c. -2.7 $-\frac{13}{5}$

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29. Express each term in common fraction form (as a quotient of two integers).

a. 0.19

b. $-0.\overline{7}$

c. $-1\frac{2}{5}$

d. 3.09

230. Which rational number is greater?

a. $-0.\overline{7}$ or -0.7?

b. -0.25 or $-\frac{1}{3}$?

c. $-\frac{2}{3}$ or $-\frac{4}{5}$?

<u>Extra for Experts</u>

31. List the set of all Integers greater than -4 and less than $\frac{1}{3}$.

32. Is $\sqrt{\frac{4}{25}}$ rational or irrational? Give a reason for your answer.

33. Is the sum of the following numbers rational or irrational? Give a reason for your answer.
$0.1 + 0.01 + 0.001$

34. Is the sum of the following numbers rational or irrational? Give a reason for your answer.
$0.333\ldots + 0.666\ldots + 0.999\ldots$

35. If the sum of 3.72 + 12.<u>ab</u> is an integer, what digits must go in place of <u>ab</u>?

36. If the sum of $\mathbf{-12} + \mathbf{-8}\frac{1}{2} + \boldsymbol{n}$ is a Natural number, what is the smallest number that can replace $\boldsymbol{n}$?

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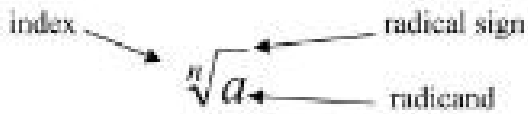
1.2 Powers and Roots of Numbers

If we raise a number to a **positive integer power**, we multiply it by itself that number of times. For example, 5 to the power 3 is 5^3 is equal to $5 \times 5 \times 5 = 125$, or 7 to the power 2 is 7^2 is equal to $7 \times 7 = 49$.

When we go in the opposite direction, instead of raising a number to a power, we find the **root** of a number. For example, the second or square root of 16 is 4 since 4 is one of its two equal factors. The third or cube root of 27 is 3 because it is one of its three equal factors.

We use the **radical sign** to represent the root of a number. The number under the radical sign is called the **radicand** and the root is called the **index**.



Examples:

$\sqrt[2]{64}$ - the square (or second) root of 64

The radicand is 64. The index is 2. Since square roots are very common, we usually leave the index out so that $\sqrt[2]{64} = \sqrt{64}$

$\sqrt[3]{1000}$ - the cube (or third) root of 1000

The radicand is 1000. The index is 3.

Raising a number to a Power

The process of **squaring a number** (raising it to the power 2) involves multiplying it by itself for a total of 2 factors.

Examples: $5^2 = 5(5) = 25$, $(\frac{3}{7})^2 = (\frac{3}{7})(\frac{3}{7}) = \frac{9}{49}$

The process of raising a number to the power 3 involves multiplying it by itself twice for a total of 3 factors.

Examples: $2^3 = 2(2)(2) = 8$, $7^3 = 7(7)(7) = 343$

Finding the Root of a number

The process of finding the **square root** of a number is to determine one of its two equal factors; for example, $\sqrt{25} = \sqrt{(5)(5)} = 5$. It should be noted that $\sqrt{25} = \sqrt{(-5)(-5)} = -5$ as well; however, in most cases, when finding the square root of a number we will take only the positive square root of a number which is called the **principal square root**.

The process of finding the **cube or third root** of a number is to determine one of its three equal factors; for example, $\sqrt[3]{125} = \sqrt[3]{(5)(5)(5)} = 5$.

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If we wanted to find the 4th root of a number, it would be one of its four equal factors. The fifth root would be one of its five equal factors, and so on.

Examples with Solutions

1. What is the index and radicand of each of the following radicals?

   a. $\sqrt{121}$ — Index is 2. (If no number is shown as the nth root, it is understood to be 2.) Radicand is 121.

   b. $\sqrt[3]{\frac{8}{27}}$ — Index is 3. Radicand is $\frac{8}{27}$.

   c. $\sqrt[4]{0.008}$ — Index is 4. Radicand is 0.008.

2. Find the value of each of the following numbers written to a power.

   a. 3^4 — $3^4 = 3(3)(3)(3) = 81$

   b. $\left(\frac{1}{2}\right)^3$ — $\left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{8}$

   c. $(0.5)^4$ — $(0.5)^4 = (0.5)(0.5)(0.5)(0.5) = 0.0625$

3. Find the value of each of the following radicals.

   a. $\sqrt{81}$ — It is the square root, so look for one of two equal factors under the radical sign
   $\sqrt{81} = \sqrt{9 \bullet 9} = 9$

   b. $\sqrt[3]{\frac{1}{8}}$ — It is the third root, so look for one of three equal factors under the radical.
   $\sqrt[3]{\frac{1}{8}} = \sqrt[3]{\frac{1}{2} \bullet \frac{1}{2} \bullet \frac{1}{2}} = \frac{1}{2}$

   c. $\sqrt[4]{16}$ — It is the fourth root, so look for one of four equal factors under the radical.
   $\sqrt[4]{16} = \sqrt[4]{2 \bullet 2 \bullet 2 \bullet 2} = 2$

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Summary of Ideas

Since	Can be shown as	We say	We write
36	6^2	A 2nd root of 36 is 6.	$\sqrt{36}=\sqrt{6\bullet 6}=6$
125	5^3	A 3rd root of 125 is 5.	$\sqrt[3]{125}=\sqrt[3]{5\bullet 5\bullet 5}=5$
32	2^5	A 5th root of 32 is 2.	$\sqrt[5]{32}=\sqrt[5]{2\bullet 2\bullet 2\bullet 2\bullet 2}=2$
16	2^4	A 4th root of 16 is 2.	$\sqrt[4]{16}=\sqrt[4]{2\bullet 2\bullet 2\bullet 2}=2$

Exercises 1.2

1. What is the radicand and the index of each of the following radicals?

   a. $\sqrt[3]{27}$

   b. $\sqrt{\frac{4}{9}}$

   c. $\sqrt[4]{625}$

   d. $\sqrt[2]{\frac{4}{121}}$

   e. $\sqrt[3]{3.375}$

   f. $\sqrt[5]{0.0032}$

2. Write a radical expression with each given index and radicand.

   a. index = 2, radicand = 81

   b. index = 3, radicand = 216

   c. index = 4, radicand = 625

   d. index = 2, radicand = 0.09

   e. index = 5, radicand = 32

   f. index = 3, radicand = $\frac{27}{125}$

3. Find the value of each of the following numbers written to a power.

   a. 3^5

   b. $(0.03)^3$

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c. $\left(\frac{2}{3}\right)^3$

d. $\left(\frac{9}{2}\right)^2$

e. $(0.2)^5$

f. $(0.03)^4$

4. Find the value of each of the following radicals.

a. $\sqrt[3]{27}$

b. $\sqrt{\frac{4}{9}}$

c. $\sqrt[4]{625}$

d. $\sqrt[2]{\frac{4}{121}}$

e. $\sqrt[3]{0.001}$

f. $\sqrt[4]{0.0016}$

g. $\sqrt[4]{\frac{1}{81}}$

h. $\sqrt[3]{\frac{8}{125}}$

i. $\sqrt{144}$

j. $\sqrt[4]{256}$

k. $\sqrt{0.09}$

l. $\sqrt[3]{1}$

5. What is the third root of sixty-four?

6. What is the square root of four-ninths?

7. What is the fourth root of sixteen eighty-firsts?

8. What is the third root of eight twenty-sevenths?

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ANSWERS TO EXERCISES AND CHAPTER TESTS

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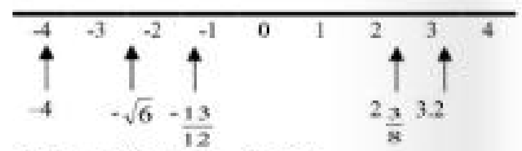
UNIT 1

Exercises 1.1 (page 6)

Number	Rational/ Irrational	Reason
1. 0.017	*Rational*	*Can be written as* $\frac{17}{1000}$
2. $7\frac{1}{2}$	*Rational*	*Can be written as* $\frac{15}{2}$
3. 5.0900134...	*Irrational*	*Decimal doesn't terminate or repeat*
4. 0.333....	*Rational*	*Repeating decimal equal to* $\frac{1}{3}$
5. -9.001	*Rational*	*Can be written as* $-\frac{9001}{10\,000}$
6. $\sqrt{64}$	*Rational*	*Equal to 8*
7. 0.14431353...	*Irrational*	*Decimal doesn't terminate or repeat*
8. 0.313131...	*Rational*	*Repeating decimal equal to* $\frac{31}{99}$
9. 510.013	*Rational*	*Terminating decimal*
10. $\sqrt{6}$	*Irrational*	*Decimal value doesn't terminate or repeat 2.44948974...*
11. -5.666...	*Rational*	*Decimal repeats and can be written as* $-\frac{17}{3}$
12. 4.009	*Rational*	*Decimal terminates and can be written as* $\frac{4009}{1000}$
13. $-343\frac{1}{3}$	*Rational*	*Can be written as* $-\frac{1030}{3}$

		Set of Numbers				
	Number	**N**	**W**	**I**	**Ra**	**Ir**
14.	0.8				√	
15.	-35			√	√	
16.	$\frac{17}{7}$				√	
17.	0.15243...					√
18.	$0.\overline{7}$				√	
19.	3	√	√	√	√	
20.	$1\frac{3}{8}$				√	
21.	-155			√	√	
22.	0		√	√	√	
23.	$\sqrt{100}$	√	√	√	√	
24.	0.83				√	
25.	$\sqrt{20}$					√

26.



27. a) -5.71, -5.17, -1.57, -0.517
b) $-\frac{11}{3}$, -3.5, -3.4, 3.4 **c)** $-\frac{2}{3}$, - 0.6, -0.4, $-\frac{3}{8}$

28. a) < **b)** = **c)** < **29. a)** $\frac{19}{100}$ **b)** $-\frac{7}{9}$ **c)** $-\frac{7}{5}$

d) $3\frac{9}{100} = \frac{309}{100}$ **30. a)** -0.7 (it is to the right of $-0.\overline{7}$ on the number line) **b)** -0.25
c) $-\frac{2}{3}$ (change to $-\frac{10}{15}$ and $-\frac{12}{15}$)

31. -3, -2, -1, 0
32. Rational – can be written as $\frac{2}{5}$
33. Rational – can be written as $\frac{111}{1000}$
34. Rational – can be written as 2
35. 28 **36.** $21\frac{1}{2}$

Exercises 1.2 (page 11)
1. a) index = 3; radicand = 27 **b)** index = 2; radicand = $\frac{4}{9}$ **c)** index = 4; radicand = 625 **d)** index = 2; radicand = $\frac{4}{121}$ **e)** index = 3; radicand = 3.375 **f)** index = 5; radicand = 0.0032 **2. a)** $\sqrt{81}$ **b)** $\sqrt[3]{216}$ **c)** $\sqrt[4]{625}$ **d)** $\sqrt{0.09}$ **e)** $\sqrt[5]{32}$ **f)** $\sqrt[3]{\frac{27}{125}}$

3. a) 243 **b)** 0.000027 **c)** $\frac{8}{27}$ **d)** $\frac{81}{4}$ **e)** 0.00032 **f)** 0.00000081 **4. a)** 3 **b)** $\frac{2}{3}$ **c)** 5 **d)** $\frac{2}{11}$ **e)** 0.1 **f)** 0.2 **g)** $\frac{1}{3}$ **h)** $\frac{2}{5}$ **i)** 12 **j)** 4 **k)** 0.3 **l)** 1 **5.** 4 **6.** $\frac{2}{3}$ **7.** $\frac{2}{3}$ **8.** $\frac{2}{3}$

Exercises 1.3 (page 25)
1. a) $\sqrt{5}, 3, \sqrt{11}, 4$ **b)** $\sqrt{3}, \sqrt{3.5}, 2, 3$

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c) $\sqrt{5}, \sqrt{6}, 2.5, 4$ **d)** $\sqrt{\frac{1}{8}}, \frac{1}{2}, \sqrt{2}, 2$
e) $\sqrt[3]{25}, 3, \sqrt[3]{60}, 4$ **f)** $1, \sqrt[3]{2}, \sqrt[3]{7}, 2$ **2. a)** 3.16
b) 0.71 **c)** 10.95 **d)** 2.41 **e)** 7.35 **f)** -5.48
g) 0.71 **h)** 4.33 **3. a)** 2.76 **b)** 4.82 **c)** 1.74
d) 4.65 **e)** 6.67 **f)** 14.12 **g)** 0.63 **h)** -5.90
4. a) $2, \sqrt{5}, 2\sqrt{3}$ **b)** $3, 2\sqrt{3}, 3\sqrt{2}, 5$

Exercises 1.4 (page 18)
1. a) $2\sqrt{6}$ **b)** $5\sqrt{2}$ **c)** $5\sqrt{3}$ **d)** $7\sqrt{3}$ **e)** $3\sqrt{7}$
f) $2\sqrt{11}$ **g)** $3\sqrt[3]{2}$ **h)** $2\sqrt[3]{5}$ **i)** $5\sqrt[3]{2}$ **j)** $3\sqrt[3]{5}$
2. a) $2a\sqrt{3}$ **b)** $ab\sqrt{2b}$ **c)** $9b^2\sqrt{a}$ **d)** $xy\sqrt{6x}$
e) $\frac{1}{2}ab\sqrt{a}$ **f)** $abc\sqrt{abc}$ **g)** $2x\sqrt[3]{5}$ **h)** $3y\sqrt[3]{y}$
i) $2a\sqrt[3]{2a}$ **j)** $abc\sqrt[3]{2}$ **3. a)** $\sqrt{45}$ **b)** $\sqrt{12n^3}$
c) $\sqrt{98ab}$ **d)** $\sqrt{75a^3b}$ **e)** $\sqrt[3]{40}$ **f)** $\sqrt[3]{27a^3b}$
g) $\sqrt[3]{\frac{2}{17}}$ **h)** $\sqrt[3]{8a^4b^4}$

Exercises 1.5 (page 22)
1. 11 **2.** 2 **3.** 3 **4.** 18 **5.** 9 **6.** 1 **7.** 7 **8.** 1
9. 8 **10.** 2 **11.** 11 **12.** 30 **13.** 20 **14.** 0 **15.** 0
16. $4\sqrt{2}$ **17.** $9\sqrt{13}$ **18.** $6\sqrt{6}$ **19.** $5\sqrt{2}$
20. $-\sqrt{2}$ **21.** $7\sqrt{3}$ **22.** $\sqrt{2}$ **23.** $4\sqrt{5}$ **24.** $7\sqrt{5}$
25. $2\sqrt{3}$ **26.** $2\sqrt{2}$ **27.** $5\sqrt{5}$ **28.** 0 **29.** $-13\sqrt{3}$
30. $10\sqrt{6}$ **31.** $6\sqrt{5}$ **32.** $13\sqrt{2} - 2$ **33.** $3\sqrt{x} - 2$
34. $-x\sqrt{3}$ **35.** $\sqrt{3x} + 10$ **36.** $-\sqrt{x} + 14$
37. $-3\sqrt[3]{a} + 5$ **38.** $-4a\sqrt[3]{2} + 25$

Exercises 1.6 (page 26)
1. a) $20\sqrt{3}$ **b)** $-36\sqrt{2}$ **c)** $12\sqrt{3}$ **d)** $-12\sqrt{10}$
e) $12\sqrt{15}$ **f)** $-12\sqrt{30}$ **g)** $6\sqrt{6}$ **h)** $2\sqrt{10}$ **i)** 504
j) $\sqrt{14} + \sqrt{6}$ **k)** $\sqrt{15} - \sqrt{6}$ **l)** $6 + 2\sqrt{5}$
m) $6\sqrt{5} - 18$ **n)** $5\sqrt{10} - 15\sqrt{6}$
o) $24\sqrt{7} + 60\sqrt{3}$ **p)** $54\sqrt{6} - 180$ **2. a)** $2a\sqrt{6}$
b) $9ab\sqrt{2}$ **c)** $4x\sqrt{3}$ **d)** $6\sqrt{3abc}$ **e)** $90n\sqrt{2}$
f) $10x\sqrt{3x}$ **g)** $a\sqrt{3} - 3\sqrt{5a}$ **h)** $6x\sqrt{2} + 2\sqrt{6x}$
3. a) 2 **b)** 4 **c)** 3 **d)** $\sqrt{2}$ **e)** $\sqrt{5}$ **f)** $\sqrt{\frac{1}{3}}$ or $\frac{1}{\sqrt{3}}$ or
$\frac{\sqrt{3}}{3}$ **g)** $2\sqrt{2x}$ **h)** 2x **i)** $5x\sqrt{2}$ **j)** $2\sqrt{2x}$

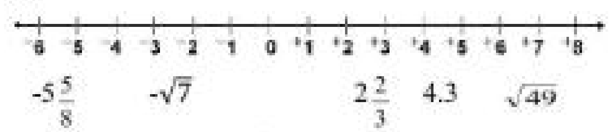
Exercises 1.7 (Page 31)
1. $x^{\frac{4}{3}}$ **2.** $y^{\frac{2}{5}}$ **3.** $b^{\frac{4}{3}}$ **4.** $5^{\frac{1}{4}}t^{\frac{3}{4}}$ **5.** $a^{-\frac{1}{3}}$ **6.** $x^{\frac{7}{12}}$
7. $x^{\frac{7}{12}}$ **8.** $(ab)^{\frac{1}{6}}$ **9.** $x^{\frac{5}{12}}$ **10.** $x^{\frac{7}{30}}$ **11.** $\sqrt{5x}$
12. $\sqrt[4]{7^3}$ **13.** $\frac{1}{\sqrt[7]{x}}$ **14.** $\frac{1}{\sqrt[5]{a^6}}$ **15.** $9\sqrt{x}$ **16.** 4
17. 2 **18.** 2 **19.** $\frac{1}{2}$ **20.** 27 **21.** $-\frac{1}{3}$ **22.** 125
23. -4 **24.** $\frac{1}{27}$ **25.** 27 **26.** $\frac{1}{8}$ **27.** $\frac{343}{125}$ **28.** $\frac{1}{5}$
29. $x^{\frac{11}{6}}$ **30.** $x^{\frac{17}{12}}$ **31.** $x^{\frac{3}{8}}y^{\frac{5}{8}}$ **32.** $x^{\frac{4}{3}}y^{\frac{8}{3}}$
33. $9x^{-4}y^6$ **34.** $x^{3.5}$ **35.** $x^{5.5}$ **36.** $\frac{a^3}{2}$ **37.** $\frac{a^6}{b}$
38. $\frac{4}{\sqrt{x}}$ or $\frac{4\sqrt{x}}{x}$ **39.** $\frac{8x^3}{27}$ **40.** $\frac{1}{x^8y^2}$ **41.** $\frac{\sqrt{x}}{y}$
42. $\frac{x^2}{\sqrt{y}}$ or $\frac{x^2\sqrt{y}}{y}$ **43.** $\frac{x^6}{x^9}$ **44.** $y\sqrt{xy}$
45. $\frac{x^4}{y^2\sqrt{y}}$ or $\frac{x^4\sqrt{y}}{y^3}$

Exercises 1.8 (page 35)
1. a) edge = 4.64 cm; area of face = 21.54 cm^2
b) edge = 2.80 cm; area of face = 7.85 cm^2
2. a) 3.34 kg **b)** 9.97 kg **3. a)** 1.81 kg
b) 37 kg **4. a)** 44.18 m **b)** 0.43 m
5. a) 2.16 m^2 **b)** 130.87 cm **c)** 300.86 kg
6. a) 2010.6 cm^3 **b)** 9.55 cm **c)** 10.70 cm
7. a) 4188.79 cm^3 **b)** 13.37 cm

Unit 1 Test (page 40)

	Number	N	W	I	Ra	Ir
1.	-13			x	x	
2.	4.13521…					x
3.	15.012				x	
4.	$\sqrt{64}$	x	x	x	x	
5.	$-\frac{12}{3}$			x	x	

6.



7. $-\frac{4}{5}$, -0.4, 0.65, $\sqrt{6}$, $3\frac{3}{8}$ **8. a)** index = 4;
radicand = 81 **b)** index = 2; radicand = $\frac{1}{9}$
9. a) $\sqrt[3]{125}$ **b)** $\sqrt{\frac{1}{4}}$ or $\sqrt[2]{\frac{1}{4}}$ **10. a)** 3125
b) 0.0004 **11. a)** 2 **b)** $\frac{3}{6}$ or $\frac{1}{2}$ **c)** $\frac{1}{3}$ **d)** 0.1
12. $\frac{1}{2}$ **13.** $\frac{3}{7}$ **14. a)** $2, \sqrt{5}, \sqrt{20}, 5$
b) $\sqrt{1.5}, 2, 3, \sqrt{11}$ **15. a)** 5.92 **b)** 0.89
c) 3.46 **d)** -0.5 **16. a)** 2.49 **b)** 7.44 **c)** 4.93

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