Reaching Algebra Readiness (RAR)

Preparing Middle School Students to Succeed in Algebra - The Gateway to Career Success

Tony G. Williams

Research has shown that algebra is the doorway and gateway for future success of students in many aspects, including high school graduation, attending and success in college, and professional earning power. And the most important key to students’ success in algebra is their readiness. This book is not only a program that addresses algebra readiness; it is also a fundamental reform effort, based on the National Mathematics Advisory Panel’s (NMAP’s) Final Report (spring, 2008). The book approaches mathematic skills deficiencies on an individual basis, much like an IEP addresses the individual needs of a student with disabilities. The Reaching Algebra Readiness (RAR) process consists of four components: (1) Diagnostic, assessing student’s mastery of the skills needed to take algebra; (2) Prescriptive, developing an individualized plan to address specific math deficiencies; (3) Intervention, utilizing tools and resources (parental involvement, effective teaching strategies, etc.), to improve students’ mathematics skills; and (4) Drills and Effective Teachings Strategies, mathematics is a discipline and, simply, there is no way of avoiding practice and drilling in reaching algebra readiness, which can be enhanced significantly by implementing proven effective teaching strategies. The Reaching Algebra Readiness (RAR) process and the related materials presented in this book will be revolutionary in helping all students acquire the math skills needed for success in algebra and beyond.

This book is a must-guide for math teachers, parents who home school, parents who are looking for solutions, and educators pursuing fundamental education reforms.
Reaching Algebra Readiness (RAR)
Preparing Middle School Students to Succeed in Algebra – The Gateway to Career Success

By

Tony G. Williams
Dedicated to my Uncle Charles, the greatest mathematical and musical mind whom I’ve ever known; and to my siblings, Cheryl and Bruce, who have followed the path of my parents to become outstanding math educators.
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Dear Teacher or Parent,

Middle school math occurs at critical phase in the lifespan of student learning. This is the time to close any gaps that exist between the acquisition of a mathematics knowledge base and the skills necessary to succeed in high school and beyond. Essentially, middle school math is both the bridge and the gateway for students. Math skills, that are fortified and expanded in middle school, are needed for completing algebra, which is a deciding factor in determining success for most students. There is a positive correlation between completing algebra and being college bound, highly employable, enrolled in higher math and sciences courses, and confident in higher learning. Students who develop sound fundamental math skills in middle school generally do well in algebra. Problems tend to occur when students have not obtained the necessary skills from their middle school mathematics programs.

The National Mathematics Advisory Panel’s (NMAP’s) Final Report (Spring, 2008) presented recommendations addressing critical concerns about mathematics achievement of our nation’s students, particularly in middle schools where the sharp falloff in mathematics achievement in the U.S. begins. A key recommendation of the panel was the need to place increased emphasis on the most critical knowledge and skills leading to algebra. Among ways to accomplish this, the panel suggested streamlining the middle school math curriculum into the most critical topics and the use of drills and exercises to enhance skills that rely on an “automatic (i.e. quick and effortless) recall of facts”. Implementing the panel’s recommendations and developing a practical and useful resource for teachers/parents of middle school students were the motivations for the development of this book.

Teachers/parents, in this book, you will find a comprehensive process for ensuring your students/child will receive the tools necessary to succeed in algebra. The Reaching Algebra Readiness (RAR) Process consists of four components: (1) Diagnostic, assessing student’s mastery of the skills needed to take algebra; (2) Prescriptive, developing an individualized plan to address specific math deficiencies; (3) Intervention, utilizing tools and resources (parental involvement, effective teaching strategies, etc), to improve students’ mathematics skills; and (4) Drills and Effective Teachings Strategies, mathematics is a discipline and, simply, there is no way of avoiding practice and drilling in reaching algebra readiness, which can be enhanced significantly by implementing proven effective teaching strategies.
FOREWORD

In this book, the middle school math curriculum has been streamlined to include the most critical topics (whole numbers, decimals, fractions, integers, percents and number concepts, problem solving, and integers and pre-algebra). The diagnostic, prescriptive, and intervention components of the RAR process are all centered on the most critical topic areas. Teaching strategies for the critical math topics are presented in the book and are accompanied with practical drills and exercises that may be used in the classroom. There is no requirement, however, that practice and drills can’t be fun. In this book, every effort has been made to create drills and exercises that are engaging and motivating. The exercises and drills are presented on ready-to-use, black line masters and many include a mini-lesson on the skills involved. Solution keys are also provided for each exercise and drill, along with a grading rubric for all assessments. The exercises and drills can be easily copied and/or made into transparencies for full class instruction and discussion.

I hope you find the Reaching Algebra Readiness process and its related materials useful in helping your students acquire the math skills needed for success in algebra and beyond.

Sincerely,

Tony G. Williams, Ed.D.
The Challenge Ahead. The primary challenge facing middle school math teachers is how to ready their students for algebra, which, as supported by overwhelming research, is the gateway to success for many students. There is a substantial correlation between students completing algebra and enrolling in four-year colleges (Horn and Nunez, 2000). Students who complete Algebra\(^1\) are twice as likely to graduate from college as students who lack such preparation (Adelman, 1999; Evan, Gray, and Olchefske, 2006). The majority of employees who earn more than $40,000 a year completed algebra in high school (Achieve Inc., 2006). A national poll revealed that two-thirds of the students who completed algebra were well prepared for demands of the workplace (Carnevale and Desrochers, 2003). And yet, there are increasing numbers of students who are not prepared for and fell to successfully complete algebra, as evident by the vast and growing demand for remedial mathematics education among arriving students in four-year colleges and community colleges across the nation. Data show that 71% of America’s degree-granting institutions offer an average of 2.5 remedial courses for skill-deficient students (Business Higher Education Forum, 2005). Overall, these deficiencies are further intensified by factors such as income and race. Research shows that most children from low-income backgrounds enter school with far less knowledge than their peers from middle-income backgrounds, the achievement gap in mathematical knowledge progressively widens throughout their Prek-12 years (NMAP, 2008). However, these achievement gaps can be significantly reduced or even eliminated if low income and minority students increase their success in high mathematics and science courses (Evan, Gray, and Olchefske, 2006).

The problem rests not so much in the way algebra is taught as it does in the preparation that students are given. The NMAP final report states that the problems in mathematics learning in the U.S. increase in late middle school before students move into algebra. Results on the National Assessment of Education Progress (NAEP) show near historic highs at Grade 4, yet by Grade 12 no progress on the assessment is evident. In the Trends in Mathematics and Science Study (TIMSS), Grade 8 students in the U.S. did not score as well as students in Grade 4. It is evident that the drop-off is occurring at that crossroads in student achievement –

\(^1\) The word “algebra” is capitalized when referring to the particular course sequence of Algebra I and II.
middle school. Middle school is the critical stage for closing any gaps between the students’ knowledge base and the math skills needed to succeed in algebra. This is the charge facing today’s middle school mathematics teachers and the parents/guardians of middle school students. It is further compounded by a myriad of factors and issues (economic, political, cultural, and societal) impacting education. School discipline remains a high concern for teachers. There is too much time spent on classroom management and discipline, which takes away from valuable classroom instruction. And now, we’re in an age where teachers must compete for their students’ attention against a number of influences (Internet, television, video games, peer and social pressures.)

As daunting as it may seem, the challenge of readying all middle school students for algebra is quite achievable. The book sets out to show you how. Although a great deal of the NMAP’s recommendations must be implemented on a broad and national scale, this book will focus on helping you, as a math teacher/parent, in readying your students/child for success in algebra, which provides unique opportunities and opens academic doors for a vast number of students of diverse backgrounds and unique abilities.

There are four primary focuses in the book: diagnostic, prescriptive, implementation, and practice/drill. Each is critically important in addressing any math skills-deficiencies that remain in middle school that will inhibit students for succeeding in algebra.

**Diagnostic.** In order to know what work needs to done, we must first assess, on an individual basis, students’ current level of skills pertaining to algebra readiness. A key question is: What skills are needed for students to be considered ready for algebra? Over the years there has been some debate over the prerequisite skills needed for success in algebra. However, most successful mathematics educators will agree, as supported by a NMAP survey of 743 active algebra teachers, that the essential foundation skills are as follows: (1) accurate and timely computational skills with whole number; (2) proficient computational skills with decimals; (3) proficient computational skills with fractions; (4) general understanding of number concepts including basic percents; (5) understanding of general concepts, proportions, and basic geometry; (6) competency in solving simple word problems; and (7) basic understanding of integers, variables, and simple equations. Chapter 2 in this book addresses the diagnostic component of the RAR process. Included are two Algebra Readiness Assessments, which measure each of the essential foundation skills necessary to reach algebra readiness. (Answer keys and grading scales to measure levels of proficiency are also included.) For practical purposes, the threshold for algebra readiness is set at a 90% rate on the assessments, although there is consideration for students who are within certain ranges of reaching algebra readiness. Depending on their deficiencies and work ethnic/motivation, some students may be given brief remediation, tutoring, and/or refresher activities and retested soon after.

**Prescriptive.** For students who are not quite algebra-ready, we must accurately determine specific math skill-deficiencies in order for us to provide them with the appropriate intervention(s). In Chapter 3, teachers/parents, you will learn how to
“drill down” to identify specific deficiencies, then develop a plan accordingly. In much the same way an Individualized Education Program (IEP) is used to plan and document special education services for students with disabilities, teachers will be able to plan and chart areas of interventions needed to help students reach algebra readiness. Using the results of an Algebra Readiness Assessment and the Unit Assessments (Chapter 4) that are presented in the unit, teachers will learn how to develop an Individualized Mathematics Invention Plan (IMIP) to plan a course of intervention for their students and record their progress.

Intervention. Chapter 5 explores various interventions and strategies that might be considered in order to help students reach algebra readiness. It focuses on implementing IMIPs utilizing a broad range of interventions including, but not limited to the following: parental involvement, tutoring, drills, worksheets (practice supplements and reinforces), technology (internet and computers), supplemental quizzes, counseling, and study-skills enhancers. The interventions and strategies address specifically the current demands and challenges facing today’s math teachers, particularly in large urban school settings, as they attempt to ready students for algebra. This chapter will show teachers/parents how to address the individual mathematics deficiencies of their students/children, while continuing to implement the requirements of their middle school mathematics curriculum. Using the provided Algebra Readiness Class Tracking Chart, teachers/students will be able to provide targeted supplements, reinforcements, and assessments for students who need them without subjecting other students to a needless and, often uninspiring, review of basic math skills.

Drills and Effective Teaching Strategies. In addition to specially designed practice exercises, drills, and tailored quiz/test supplements, Chapters 6–12 will provide valuable tips and strategies addressing the common problems in each of the foundation areas. The teaching strategies presented for each foundation area are based on sound and proven instructional practices. Special attention is given to whole numbers, particularly multiplication, with a focus on both accuracy and timeliness. As much as possible, each drill and exercise was developed to be engaging and motivating while improving student algebra readiness in the critical areas. Each exercise and drill is presented on a ready-to-use, reproducible black line master and many come with a mini-lesson. Also, solution keys are provided, along with a grading rubric for all assessments. Included in Chapters 6–12 are supplemental quizzes and post-assessments for students after they have received adequate instructional interventions.

HOW TO BEST USE THIS BOOK

Far most, this book should be used to assess algebra readiness. Whether you are a teacher, parent, guidance counselor, etc., the algebra readiness assessments will provide valuable information and lead the way in determining next steps. Guidance counselors will find the assessment helpful in making placement decisions, while those teaching an algebra course may use the assessment results to verify proper
placement. The assessment can also inform algebra teachers of the extent of any skill deficiencies that a student may have and guide them in plotting a course of action, whether it is a few review exercises or a possible schedule change. Middle school math teachers preparing students for algebra should, within the first few days of school year, administer the Algebra Readiness Assessment and, based on the results, plot an individual course of action for each student. For students who score high (90% or above) on the Algebra Readiness Assessment, consideration should be given to changing their schedules to algebra. For students who are not yet algebra ready, teachers/parents should develop an Individualized Mathematics Intervention Plan (IMIP) and put in place appropriate interventions, strategies, and materials (drills, exercises, supplemental quizzes, tests, etc.) presented in the book. Student progress should be recorded and tracked using the provided Algebra Readiness Class Tracking Chart Provided. The strategies and interventions presented in this book should be reviewed and implemented in a way that works best for you as you work to meet the needs of your students.
CHAPTER 2
DIAGNOSTIC

The first step in preparing middle school students to enroll in and successfully complete Algebra is to accurately diagnose their abilities and skills pertaining to those deemed necessary to be considered “ready for algebra.” Diagnosing students’ algebra-readiness for the purpose of providing targeted remediation has been regularly missing from instructional strategies in recent years. Often times, such determinations – if made at all – have been conducted too late to provide students with the individual supports that they need to become algebra ready. No Child Left Behind (NCLB) has led the way in promoting accountability and achievement for students with varying backgrounds, motivational levels, and abilities. However, under NCLB, states vary considerably in assessment standards, requirements, and proficiency determinations. Also, although its intentions are noble, NCLB, as it relates to middle school math, does not focus enough on the skills needed for algebra as suggested by the NMAP. In its final report, the NMAP suggested that state assessments for students through Grade 8 focus on and adequately represent the Panel’s Critical Foundations for Algebra.

A key to the success of the Reaching Algebra Readiness system is its proactive approach. The diagnosis of students’ math skills is done to determine which students are algebra-ready and, more importantly, to provide specific individualized assistance to those students who have not yet mastered those essential skills. Remediation of deficient skills will be done without compromising the current middle school mathematics curriculum and state/district assessments requirements.

This chapter presents two versions of the Algebra Readiness Assessment (ARA), a 33-problem test designed to measure students’ skills in each of the seven critical areas that are needed to be Algebra ready. The assessments are manual, paper and pencil exams with students showing their work and providing the answers. There are no “choice” answers from which to select. What’s at stake is too important to allow possible chance or guessing to be factored into the outcome determination. (However, given the demands and time restraints facing many teachers, a multiple-choice version of an assessment is also provided.) Included for each assessment is a grading key and scoring rubric. A passing score on the assessment has been set high (90%) because of the essential nature of these mathematics skills in correlation with success in Algebra.
CHAPTER 2

The ARA measures students’ mathematics skills on each of the following critical areas: (1) accurate and timely computational skills with whole number; (2) proficient computational skills with decimals; (3) proficient computational skills with fractions; (4) general understanding of number concepts including basic percents; (5) understanding of number concepts and basic geometry; (6) competency in solving simple word problems; and (7) basic understanding of integers, variables, and simple equations. Although there are some ongoing discussions over the perquisite skills needed for success in algebra, nationally, most successful mathematics educators will agree, as supported by a NMAP survey of 743 active algebra teachers, that the skills assessed in the ARA are most critical.

The Algebra Readiness Assessment (ARA) should be administered at the beginning of the middle school year in each math course – general math, pre-algebra, or algebra I. Students who pass the ARA (90% or above) should be considered for a schedule change into algebra, if they are not already enrolled in the course. For students scoring in that “gray area” (70 to 89%) on the assessment, it is recommended that a quick review occur followed by retesting. For all others students not passing the assessment, it is important to “drill down” to identify specific skill deficiencies followed by the development and implementation of an Individualized Mathematics Implementation Program (IMIP) to be used to prepare these students for Algebra. This prescriptive process and the development of the IMIP will be the primary focus in Chapter 3.

ALGEBRA READINESS ASSESSMENT (ARA) – (VERSION 1A)

Directions

Solve the following problems, showing as much work as needed. Calculators\(^1\) are not allowed for this assessment.

I. Whole numbers
(1) \(7,045 + 856 + 91\) \([1.1]\) (2) \(9,012 - 823\) \([1.2]\)
(3) \(603 \times 97\) \([1.3]\) (4) \(3 \sqrt[3]{11}\) \([1.4]\) (5) \(23 \sqrt[3]{5} \text{ (remainder)}\) \([1.4]\)

II. Decimals
(6) \(2.85 + 3.9 + 11\) \([2.1]\) (7) \(17.3 - 5.04\) \([2.2]\)
(8) \(28.7 \times 5.9\) \([2.3]\) (9) \(2.5 \sqrt[2]{6.25}\) \([2.4]\) (10) \(43.7 \div 100\) \([2.4]\)

\(^1\) Students with IEPs or 504 plans allowing calculators or other assistive technology may use such devices.
III. Fractions (Simplify answers if needed)

(11) \( \frac{1}{4} + \frac{5}{6} \) [3.1]
(12) \( 4\frac{2}{5} + 1\frac{1}{4} \) [3.1]
(13) \( \frac{5}{6} - \frac{1}{4} \) [3.2]
(14) \( 3\frac{7}{11} - 2\frac{4}{5} \) [3.2]
(15) \( \frac{5}{6} \cdot \frac{3}{10} \) [3.3]
(16) \( 3\frac{1}{3} \cdot 1\frac{1}{4} \) [3.3]
(17) \( 8 \div \frac{1}{3} \) [3.4]
(18) \( \frac{5}{6} \div 8\frac{1}{3} \) [3.4]

IV. Percents

(19) Write \( \frac{1}{2} \) as a percent. [4.1]
(20) Write 0.7 as a percent. [4.2]
(21) What is 25% of 80? [4.3]

V. Number concepts and basic geometry

(22) Find the average of: 23, 47, 110 [5.4]
(23) Write 24.3 in words. [5.1]
(24) What is the value of \( x : \frac{3}{2} = \frac{x}{6} \) [5.6]
(25) Compute: \( 12 - 5 \times 2 \) [5.5]
(26) Round 8.015 to the nearest hundredth. [5.3]
(27) What is the perimeter of the rectangular? [5.7]

(28) Arrange in order from least to greatest:
(a) 0.82    (b) 0.808    (c) 0.18    (d) 0.8 [5.2]

VI. Word problems

(29) Students at Central Middle School are required to perform 1800 minutes of community service each year. So far, Keisha has performed 1265 minutes and her best friend, Stephanie, has performed 178 minutes less than her. How many more minutes of community service does Stephanie need to perform to meet the school’s requirement? [6.1]

(30) Ryan made $44 by raking leaves. If worked a total of 4 hours, how much did he earn for each hour of work? [6.2]
CHAPTER 2

VII. Basic integers and pre-algebra

(31) What is \(-10 + 7\)? \[7.1\]

(32) What is \(-12 \div -3\)? \[7.2\]

(33) What is the value of \(x\): \(24 = x - 18\) \[7.3\]

ALGEBRA READINESS ASSESSMENT (ARA) – (VERSION 1B)

Directions

Solve the following problems, showing as much work as needed. Calculators\(^2\) are not allowed for this assessment.

I. Whole numbers

(1) \(9,045 + 586 + 23\) \[1.1\]

(2) \(8,902 - 697\) \[1.2\]

(3) \(903 \times 87\) \[1.3\]

(4) \(5 \overline{15}\) \[1.4\]

(5) \(27 \overline{43}\) \(\text{remainder}\) \[1.4\]

II. Decimals

(6) \(3.85 + 13 + 7.9\) \[2.1\]

(7) \(16.3 - 2.04\) \[2.2\]

(8) \(2.64 \times 1.9\) \[2.3\]

(9) \(2.7\overline{62}\) \[2.4\]

(10) \(83.7 \div 100\) \[2.4\]

III. Fractions (Simplify answers if needed)

(11) \(\frac{1}{8} + \frac{1}{6}\) \[3.1\]

(12) \(2\frac{3}{4} + 1\frac{1}{2}\) \[3.1\]

(13) \(\frac{5}{9} - \frac{7}{9}\) \[3.2\]

(14) \(9\frac{2}{5} - 2\frac{3}{5}\) \[3.2\]

(15) \(\frac{4}{5} \div \frac{5}{6}\) \[3.3\]

(16) \(2\frac{2}{3} \cdot 2\frac{1}{4}\) \[3.3\]

(17) \(9 \div \frac{1}{4}\) \[3.4\]

(18) \(\frac{3}{4} \div 4\frac{1}{2}\) \[3.4\]

IV. Percents

(19) Write \(\frac{1}{4}\) as a percent. \[4.1\]

(20) Write 0.5 as a percent. \[4.2\]

(21) What is 20% of 80? \[4.3\]

\(^2\) Students with IEPs or 504 plans allowing calculators or other assistive technology may use such devices.
V. Number concepts and basic geometry

(22) Find the average of: 53, 37, 111. \[5.4]\]

(23) Write 3.75 in words. \[5.1]\]

(24) What is the value of \( n \): \( \frac{2}{n} = \frac{1}{n} \)? \[5.6]\]

(25) Compute: \( 10 + 6 \div 2 \) \[5.5]\]

(26) Round 8.718 to the nearest tenth. \[5.3]\]

(27) What is the area of the rectangular? \[5.8]\]

(28) Arrange in order from least to greatest:
(a) 0.4 \hspace{1cm} (b) 0.05 \hspace{1cm} (c) 0.41 \hspace{1cm} (d) 0.404 \[5.2]\]

VI. Word problems

(29) Eli’s goal is to run 13 miles over 3 days. He runs 3 miles on the first day and 5 miles on the second. How many miles must he run on the third day to reach his goal? \[6.1]\]

(30) As a babysitter, Lori was paid $5.25 per hour. If she worked 6 hours, how much did she earn? \[6.2]\]

VII. Basic integers and pre-algebra

(31) What is \( -10 + (-7) \)? \[7.1]\]

(32) What is \( 12 \cdot (-3) \)? \[7.2]\]

(33) What is the value of \( x \): \( 18 + x = 31 \) \[7.3]\]

**Directions**

Solve the following problems, showing your all work on separate sheets of paper. Calculators are not allowed for this assessment. When you are finished, attach your work to the back of your answer sheet.

\(^3\) Students with IEPs or 504 plans allowing calculators or other assistive technology may use such devices.
CHAPTER 2

I. Whole numbers

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<th>Option B</th>
<th>Option C</th>
<th>Option D</th>
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<td>(1) 7,045 + 856 + 91</td>
<td>8,992</td>
<td>8,092</td>
<td>7,992</td>
<td>7,982</td>
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<tr>
<td>(2) 9,012 - 823</td>
<td>8,189</td>
<td>8,191</td>
<td>8,199</td>
<td>7,189</td>
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<td>(3) 603 × 97</td>
<td>508,491</td>
<td>58,491</td>
<td>54,491</td>
<td>58,401</td>
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<td>(4) 3,831</td>
<td>179</td>
<td>207</td>
<td>277</td>
<td>277</td>
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<tr>
<td>(5) 23,825 (remainder)</td>
<td>508,491</td>
<td>58,491</td>
<td>54,491</td>
<td>58,401</td>
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II. Decimals

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<th>Option B</th>
<th>Option C</th>
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<tr>
<td>(6) 2.85 + 3.9 + 11</td>
<td>17.75</td>
<td>6.86</td>
<td>16.95</td>
<td>16.75</td>
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<tr>
<td>(7) 17.3 - 5.04</td>
<td>12.24</td>
<td>12.26</td>
<td>11.09</td>
<td>12.01</td>
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<td>(8) 28.7 × 5.9</td>
<td>179.33</td>
<td>169.53</td>
<td>1693.3</td>
<td>169.33</td>
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<td>(9) 2.5 ÷ 6.25</td>
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<td>0.25</td>
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<td>(10) 43.7 ÷ 100</td>
<td>12.4</td>
<td>0.25</td>
<td>0.437</td>
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III. Fractions (Simplify answers if needed)

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<td>(11) 1/4 + 5/6</td>
<td>1 7/24</td>
<td>1 11/12</td>
<td>4/3</td>
<td>1 1/12</td>
</tr>
<tr>
<td>(12) 4/5 + 1 1/2</td>
<td>1 7/3</td>
<td>5 1/5</td>
<td>5 3/8</td>
<td>5 2/3</td>
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(13) $\frac{5}{8} - \frac{1}{8}$ [3.2]  
(A) $\frac{3}{4}$  
(B) $\frac{1}{4}$ or 1  
(C) $\frac{\sqrt{2}}{8}$  
(D) $\frac{3}{8}$  
(14) $3 \frac{7}{10} - 2 \frac{4}{5}$ [3.2]  
(A) $1 \frac{9}{10}$  
(B) $\frac{9}{10}$  
(C) $\frac{3}{5}$  
(D) $1 \frac{3}{10}$

(15) $\frac{5}{6} \div \frac{1}{2}$ [3.3]  
(A) $\frac{1}{2}$  
(B) $\frac{1}{4}$  
(C) $\frac{15}{2}$  
(D) $\frac{3}{2}$

(16) $3 \frac{1}{3} \cdot 1 \frac{1}{4}$ [3.3]  
(A) $3 \frac{1}{3}$  
(B) $4 \frac{2}{3}$  
(C) 4  
(D) $3 \frac{1}{3}$

(17) $8 \div 4$ [3.4]  
(A) $6 \frac{2}{3}$  
(B) $8 \frac{2}{3}$  
(C) 10  
(D) 40

(18) $5 \div 8 \frac{1}{3}$ [3.4]  
(A) $62 \frac{5}{6}$  
(B) $85 \frac{4}{5}$  
(C) 10  
(D) $40 \frac{1}{10}$

IV. Percents

(19) Write $\frac{1}{2}$ as a percent.  
(A) 0.5%  
(B) 5%  
(C) 20%  
(D) 50%

(20) Write 0.7 as a percent.  
(A) 7%  
(B) 70%  
(C) 0.7%  
(D) 35%

(21) What is 25% of 80?  
(A) 25%  
(B) 32%  
(C) 20%  
(D) 15%

V. Number concepts and basic geometry

(22) Find the average of: 23, 47, 110  
(A) 60  
(B) 180  
(C) 53  
(D) 90
(23) Write 24.3 in words. ________________________ [5.1]
(A) Twenty-four point three 
(B) Twenty-four and three 
(C) Twenty-four and three hundredths 
(D) Twenty-four and three tenths

(24) What is the value of \( x \): \( \frac{3}{2} = \frac{x}{5} \) [5.6]
(A) 3
(B) 13
(C) 9
(D) 4

(25) Compute: \( 12 - 5 \cdot 2 \) [5.5]
(A) 2
(B) 14
(C) −2
(D) 22

(26) Round 8.015 to the nearest hundredth, ________________________ [5.3]
(A) 8.01
(B) 8.02
(C) 8
(D) 8.015

(27) What is the perimeter of the rectangular? ________________________ [5.7]

(A) 10 cm 
(B) 21 cm² 
(C) 21 cm 
(D) 20 cm

(28) Arrange in order from least to greatest:
(a) 0.82 (b) 0.808 (c) 0.18 (d) 0.8 ________________________ [5.2]
(A) d, c, a, b
(B) c, b, d, a
(C) c, d, b, a
(D) d, a, c, b
VI. Word problems

(29) Students at Central Middle School are required to perform 1800 minutes of community service each year. So far, Keisha has performed 1265 minutes and her best friend, Stephanie, has performed 178 minutes less than her. How many more minutes of community service does Stephanie need perform to meet the school’s requirement? ________________ [6.1]

(A) 3240
(B) 1535
(C) 535
(D) 713

(30) Ryan made $44 by raking leaves. If he worked a total of 4 hours, how much did he earn for each hour of work? ________________ [6.2]

(A) $11
(B) $176
(C) $48
(D) $10.25

VII. Basic integers and pre-algebra

(31) What is \(-10 + 7\)? [7.1]

(A) 3
(B) \(-3\)
(C) \(-17\)
(D) 17

(32) What is \(-12 \div -3\)? [7.2]

(A) \(-4\)
(B) 4
(C) 9
(D) \(\frac{1}{4}\)

(33) What is the value of \(x\): \(24 = x - 18\)? [7.3]

(A) \(-42\)
(B) \(-6\)
(C) 6
(D) 42
### CHAPTER 2

**ANSWER KEY: ALGEBRA READINESS ASSESSMENT (ARA)**

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<th>Version 1B</th>
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* Take off 1 point if the answer is the correct one but not simplified.

**Grading Scale - Algebra Readiness Assessment (ARA)**

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| # incorrect | 18| 19| 20| 21| 22| 23| 24| 25| 26| 27| 28| 29| 30| 31| 32| 33|
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| score       | 46| 43| 40| 37| 34| 31| 28| 25| 22| 19| 16| 13| 10| 7 | 3  | 0 |   |

* Remember for problems 11-18 take off just 1 point if the answer is the correct one but not simplified.