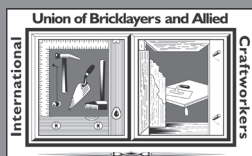# MATHEMATICS FOR BAC CRAFTWORKERS I

INTERNATIONAL UNION OF BRICKLAYERS AND ALLIED CRAFTWORKERS

BRICK | STONE | TILE | MARBLE | TERRAZZO | PLASTER | CEMENT | RESTORATION

Basic Mathematics for BAC Craftworkers

Student Workbook

International Union of Bricklayers and Allied Craftworkers

APPRENTICESHIP AND TRAINING DEPARTMENT AND NATIONAL FUND MISSION STATEMENT

The International Masonry Institute (IMI) and the International Masonry Training and Education Foundation (IMTEF) are joint labor/management organizations created through the leadership of the International Union of Bricklayers and Allied Craftworkers (BAC) and the contractors who employ BAC members. IMI works to expand and improve business opportunities for mason contractors as well as job opportunities and working conditions for BAC members. IMI promotes the quality of union-built masonry to architects, engineers, building owners, public officials, and the general public throughout the United States and Canada. IMTEF provides training to apprentices and advanced specialized training to journeyworkers, supervisors, and trade instructors.

These manuals are provided to assist in your training and educate you concerning the importance of safety on the job. It is important for you to fully understand that your employer and other employers on the jobsite are first and foremost responsible for creating a safe environment. The IMTEF is not responsible for the formulation of employer safety policies or maintenance of safety on the jobsite.

The content in these manuals is intended for the sole use of the IMTEF and its signatory employers and should not be construed to imply that no other hazards or hazardous conditions may be present in your workplace. The training guidelines and information provided in these manuals are not intended to comply with any federal, state, or local statutes pertaining to workplace training or safety and health requirements.

team

IMI

**UNION MASONRY CRAFTWORKERS
CONTRACTORS & CONSULTANTS**

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ACKNOWLEDGEMENTS

The preparation of this training material would not have been possible without the technical contributions and supportive efforts of a wide range of individuals affiliated with the **International Union of Bricklayers and Allied Craftworkers,** the **International Masonry Institute** and the **International Masonry Training and Education Foundation.**

Special Acknowledgements

A special thank you to the **BAC/IMI Apprenticeship and Training Taskforce** that is comprised of BAC Union Labor Leaders, IMI and IMTEF leaders, Apprentice Coordinators, and BAC Signatory Contractors.

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Organizations

We would like to acknowledge the International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers for their permission to use selected content in the development of this manual.

PREFACE

TRAINING PACKAGE OVERVIEW

This training package is designed for use by both the IMTEF instructor and student. There are four primary components of this package: the Student Manual, Student Workbook, Electronic Presentation, and Instructor Guide. The student needs to understand the purpose of the first three of these components for a successful training experience. Following is a brief description of each.

COURSE MATERIALS

Student Manual – The Student Manual is the heart of the training package and contains all of the information the BAC Craftworker student needs to learn during this course. The student will read the manual as assigned. The information is presented in a unit of instruction format. To support the content presented in the Student Manual, callout notes, photographs, illustrations, details, and other information are included. There is also a glossary defining key terms from the units. When first mentioned, glossary words appear in bold in the Student Manual.

Student Workbook – The student will use the workbook before and during classroom sessions throughout the course. The workbook contains Assignment Sheets for each of the Student Manual's units of instruction. These may be assigned as homework or as in-class activities for individuals or small groups of students.

Electronic Presentation – The instructor will use the presentation to enhance student understanding and facilitate engagement during classroom instruction. The Electronic Presentation will primarily support the instructor's delivery of Student Manual content. The presentation may also include informative and instructional videos and additional resources not provided in the manual. Supplemental materials, such as trade information and resources, SDSs, and course handouts, may be accessible to the instructor from the presentation interface when relevant.

A student who fully engages in the reading, workbook assignments and activities, and classroom instruction should be successful in this BAC Craftworker training.

Instructor Guide – For instructor use only.

COURSE SYLLABUS

For each course there is a course syllabus. A syllabus serves as the design document for a course, provides information about the course, and is typically given to students on the first day of class. A syllabus may include the following information:

- Course title and description

- Course objectives

- Description of the target audience and course prerequisites

- Length and dates of the course

- Location of the course

- Information about the instructors

- Description of materials the student will need and/or receive

- Description of the course assignments

- Description of the course grading criteria

- Attendance criteria

UNIT OF INSTRUCTION FORMAT

The Student Manual includes a number of units of instruction. Although the various components of a unit of instruction are separated and will appear in the Student Manual, Instructor Guide, and Student Workbook, they are considered to be part of an overall package of instruction. Each unit of instruction typically includes objectives and Assignment Sheets, Unit Tests, and (for instructors) answers to the Assignment Sheets and Unit Tests.

OBJECTIVES AND SUPPORTING MATERIAL

Each unit of instruction is based on performance objectives with clear learning outcomes. These objectives state the goals of the unit to provide a sense of direction and accomplishment for the BAC Student.

Performance objectives are stated in two forms: a unit objective, stating the subject matter to be covered in the unit, and specific objectives, stating the student performance necessary to reach the unit objective.

Objectives for each unit provide direction for the learning process, so it is important for the instructor and students to have a common understanding of the intent of the objectives. Given the importance of these objectives, they will appear in the Student Manual, Instructor Guide, and Student Workbook.

In the Student Manual, each objective is supported by a major topic within the unit, explaining and expanding on the objective. These major topics parallel the objectives as listed at the opening of the unit. If there are 10 objectives, there will be 10 major topics covered in the same order as the objectives.

Assignment Sheets

Assignment Sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge that is a necessary prerequisite to skill development. Your instructor may assign these for completion in class or as outside assignments. The Assignment Sheets are in the Student Workbook.

Knowledge and Skill Tests

Tests have been constructed to measure achievement of each objective listed in the units. Testing will help to determine if students have achieved the unit and specific objectives.

USING THIS STUDENT WORKBOOK

This Student Workbook contains the Assignment Sheets for this course. Your instructor may choose to use the Assignment Sheets during class or assign them for homework.

Prior to completing any Assignment Sheet:

1. Refer to the course syllabus to determine when each assignment is due. If this information is not available in the course syllabus, ask your instructor.

2. Read the supporting information in the unit of instruction.

3. Read the instructions for completing the Assignment Sheet.

The Assignment Sheets are knowledge checks that help reinforce and allow you to demonstrate your comprehension unit information as per the unit objectives. The Unit Test is based on the same objectives—so completing the Assignment Sheets will help you prepare for the test.

STUDYING FOR TESTS

After the class has completed a unit of instruction, the instructor may administer a Unit Test. The test only covers the information contained within the unit and is based on the specific objectives. If you study the information related to each objective, you will be ready for the test.

Here are some tips for preparing for a test:

- Study in a place that is free of distractions. Have ready all the things you will need, such as your Student Manual, paper, pencils, or a calculator.

- Study at a time when you are alert and not hungry or sleepy.

- Do not wait until the last minute to study! Short, daily study sessions are better than one long session the night before the test.

- Set a goal for each study period. Review one unit at a time to prepare for the test.

- Repetition is key! Read and reread your manual and review your notes.

- While you are reviewing your notes, cover them up periodically and summarize them out loud. Pretend that you are explaining the material to someone else. Better yet – do this with another student.

- Study with another student. Close your book and have the other student ask you questions. Then you ask the questions.

OBJECTIVES

After completion of this unit, you should be able to describe the basic history of mathematics, identify the types of number systems, and select a calculator to use for solving mathematics problems. This knowledge will be evidenced by correctly completing the Assignment Sheet and by scoring a minimum of 70% on the Unit Test.

Specifically, you should be able to:

1. Describe the basic history of mathematics.

2. Identify two basic systems of measurement used by BAC Craftworkers.

3. Select a calculator.

4. Use this Student Manual to learn mathematics required for BAC Craftworkers.

Each of these objectives is covered in the pages that follow.

ASSIGNMENT SHEET 1.1

INTRODUCTION TO MATHEMATICS

NAME:_____   SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

1 Mathematics is the study of measurement, properties, and relationships using _____ and _____.

2 How old is the field of mathematics? The answer is many _____ of years.

3 Mathematics grew rapidly in ancient _____.

4 One of the most famous ancient Greek mathematicians was _____.

5 One of the first calculating tools which used beans or stones was the _____.

6 The first mechanical calculator was developed in the 1600s and was known as the _____.

7 There are several types of modern electronic calculators. The one often used by Craftworkers that is capable of performing calculations specifically related to erecting buildings and other structures is the _____ calculator.

8 The primary system of measurements used in the United States is the United States _____ of units of measurements.

9 The primary system of measurements used in Canada and almost all of the countries of the world is the _____ system.

10 The inch and foot are basic units for measuring _____.

UNIT 2

OBJECTIVES

After completion of this unit, you should be able to solve mathematics problems involving the addition, subtraction, multiplication, and division of whole numbers. This knowledge will be evidenced by correctly completing the Assignment Sheets and by scoring a minimum of 70% on the Unit Test.

Specifically, you should be able to:

1. Add whole numbers.

2. Subtract whole numbers.

3. Multiply whole numbers.

4. Divide whole numbers.

5. Perform combined operations with whole numbers.

Each of these objectives is covered in the pages that follow.

NAME:_____   SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

## Addition of Whole Numbers

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 $15 + 37 =$ _____

2 $103 + 81 =$ _____

3 $379 + 169 + 2,387 =$ _____

4 $1,908 + 29 + 736 =$ _____

5 $12,306 + 7,003 + 14,348 =$ _____

6 $75 + 791 + 283 + 4,077 =$ _____

7 $64 + 64 + 64 =$ _____

8 $339 + 267 + 394 =$ _____

9 $79 + 658 + 1,003 + 2,687 =$ _____

10 $893 + 1,247 + 6,006 + 1,854 =$ _____

UNIT 2

Application problems

11 A rectangular piece of Bluestone measures 18" on the two long sides and 12" on the two short sides. To determine the perimeter (or length around the outside), you add the lengths of the four sides. What is the perimeter of the plate?

18"

12"   12"

18"
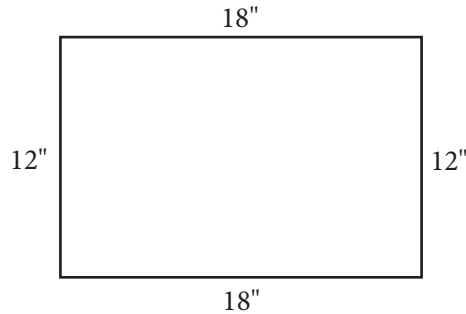
12 A blueprint indicates that special mechanical fasteners are to be used to install a series of different size panels. There are 8 panels with each requiring a different number of fasteners. Here are the numbers of fasteners required: 8, 12, 16, 20, 24, 28, 32, and 36. What is the total number required?

13 An apprentice is asked to find and distribute the sag rods needed for each elevation. The north side needs 42, the south: 29, east: 64, and the west side: 58. How many sag rods does the apprentice have to find?

14 A template needs to be fabricated that will hold in place 8 clips to be welded in the same location on each floor of the building. The center-to-center distances of these clips are 27", 33", 37", 44", 39", 34", and 25". What is the length of the template from the center of the first clip to the center of the last clip?

27"   33"   37"   44"   39"   34"   25"
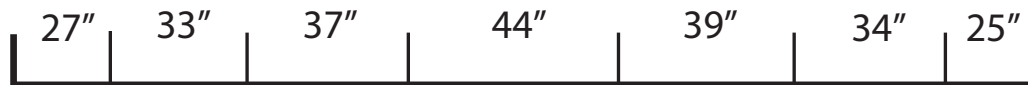
15 A truck load of concrete block was unloaded in 7 picks. The weights of the picks were 648 pounds (lbs), 798 lbs, 1,792 lbs, 1, 642 lbs, 2,438 lbs, 1,475 lbs, and 368 lbs. How many pounds of block were on the truck?

16 On Monday, an apprentice installed 230 – 3" × 3" tile and 120 – 4" × 4" tile. Tuesday, the apprentice installed 370 – 3" × 3" tile, Wednesday: 364 – 4" × 4" tile, Thursday: 430 – 3" × 3" tile, and on Friday: 411 - 4" × 4" tile. What is the total number of tile the apprentice installed during the week?

17 The concrete crew plans to pour five pads at the same time. The closest loading point to the five pours is 125'. Each pour is an additional 35' further from the closest pad. What is the distance of the furthest pad?

18 A foreman asks an apprentice to go and get a 200-foot tagline out of the trailer because they are going to do a lift to the top floor that has to be controlled from the street. When the apprentice gets to the trailer, he finds an assortment of lines of the following lengths: 1 = 26', 2 = 38', 3 = 90', and 4 = 62'. What is the length of all the lines connected together (assume no loss of rope where they are connected)? Will it be long enough?

19 Barrel #1 contains 208 anchors. Barrel #2 has 129 anchors. Barrel #3 contains 186 anchors. All three barrels are on a skid. What is the total number of barrels on the skid?

20 A BAC apprentice works 8 hours on Monday, 9 hours on Tuesday, 6 hours on Wednesday, 2 hours on Thursday (rained out), and 8 hours on Friday. What should the apprentice expect to see on the weekly check for the total number of hours worked?

UNIT 2

ASSIGNMENT SHEET 2.2

WHOLE NUMBERS

NAME:_____   SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Subtraction of Whole Numbers

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 24 − 17 = _____

2 63 − 29 = _____

3 112 − 37 = _____

4 143 − 124 = _____

5 256 − 27 = _____

6 1,309 − 984 = _____

7 1,570 − 651 = _____

8 3,657 − 1,008 = _____

9 6,541 − 957 = _____

10 13,586 − 8,047 = _____

Application problems

11 There are 587 tons of stone on the job. A large stone crew installs 119 tons the first month. Another smaller crew installs 35 more in the same month. How many tons of stone are remaining on the jobsite?

12 A truck load of granite weighs a total of 18,986 lbs. The load consists of three bundles. The first one weighs 3,768 lbs, and the second weighs 7,421 lbs. What is the weight of the third bundle?

13 One thousand pounds of sweeping compound is ordered for the job. On the first floor, 245 lbs were used. On the second floor, 327 lbs were used. How many pounds of compound were left after the first two floors?

14 A load of 18,000 pounds of rebar was delivered on Monday. The following amounts were tied in place per day: Monday: 2,200 lbs, Tuesday: 3,490 lbs, Wednesday: 1,745 lbs, and Thursday: 4,225 lbs. How much was left to tie on Friday?

15 On Friday, the apprentice receives a paycheck. After taxes, there is $620. The apprentice has to pay union dues of $30, gas for the car for $35, car insurance for $227, and groceries for $174. How much money was left until next week?

16 At the end of a three-year apprenticeship, Frank has worked a total of 4,832 hours. The first year, he worked 1,621 hours. During the second year, 1,497 hours are worked. How many hours did Frank work in the third year?

17 The distance around a piece of stone (the perimeter) is to be 36". Three of the sides measure 10", 10", and 8". What is the length of the remaining side?

UNIT 2
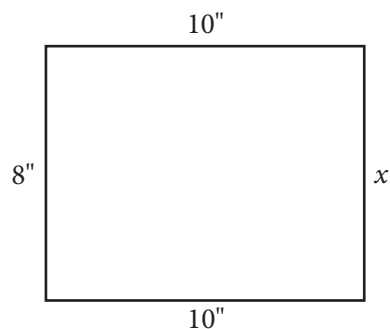
18 A BAC Craftworker can retire with a full pension when 85 points have been accumulated (points being age of the member plus years of active service). If the member starts at age 18 and works until age 50, how many points will have been accumulated?

19 A Plasterer gets 15 minutes to clean up his/her area on company time, and the normal shift ends at 4:00 p.m. It is now 3:20 p.m. How many minutes must the Plasterer continue working before starting to pack up?

20 A contractor has 88 Craftworkers on their payroll, 4 called in sick on Tuesday and 6 were laid off. How many Craftworkers are left on the payroll for Tuesday?

UNIT 2

ASSIGNMENT SHEET 2.3

WHOLE NUMBERS

NAME:_____   SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Multiplication of Whole Numbers

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 $12 \times 3 =$ _____

2 $15 \times 37 =$ _____

3 $65 \times 19 =$ _____

4 $23 \times 109 =$ _____

5 $1{,}205 \times 67 =$ _____

6 $99 \times 99 =$ _____

**7** $1{,}003 \times 157 =$ _____

8 $678 \times 876 =$ _____

9 $2{,}338 \times 532 =$ _____

10 $1{,}000 \times 1{,}000 =$ _____

Application problems

11 A team of 4 Marble Masons can install 24 large panels in a working day. How many panels can they install in 14 working days?

12 To install the masonry panels on a 48 story building, 122 specialized anchors are needed per floor. How many specialized anchors are needed for the entire job?

13 A 10" wide flange beam weighing 22 pounds per foot needs to be installed to support a stair platform. The beam is 28' long. How much weight would the chain fall used to install this beam be picking up?

14 Two apprentices shake out 247 #5 reinforcing bars that are 22' long. Each bar weighs 2 pounds per foot. How much do all of the bars weigh together?

15 According to the blueprint, 18 anchors are needed at each of 28 column connections. What is the total number of anchors needed?

16 Steel plate that is 1/4" thick weighs 10 pounds per square foot. How much does a single 3' × 7' plate used on a stair platform weigh? Note that the number of square feet is found by multiplying 3' × 7'. What is the weight of a shipment of 38 plates?

17 What is the perimeter (distance around the outside) of this hexagon if each side measures 125 millimeters (a metric unit of measurement)?
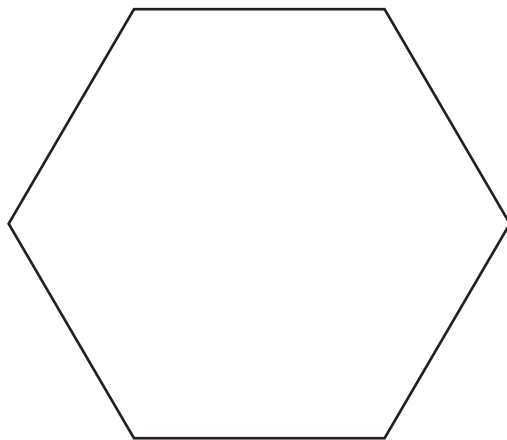
18 A typical tub surround requires 200 6" × 6" tiles. How many tiles will be required to fully install 5 tub surrounds?

19 A Bricklayer apprentice works three shifts at eight hours per shift (Monday to Wednesday), and then works three ten-hour shifts, the last one on Saturday of the same pay week. If overtime after eight hours is paid at double the effective rate, and weekends and holidays are also double time, what is the total equivalent straight time hours the apprentice should receive for this work week?

20 What is the total estimated labor cost to install 40 units of epoxy terrazzo if it takes three terrazzo mechanics 4 hours each to install a unit, and the hourly rate is $45.00?

UNIT 2

NAME:_____   SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Division of Whole Numbers

Instructions: Solve each of the following problems. If there is a remainder, express this as a whole number followed by the remainder (e.g., 6 r = 3). Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 $144 \div 6 =$ _____

2 $161 \div 7 =$ _____

3 $308 \div 11 =$ _____

4 $487 \div 46 =$ _____

5 $516 \div 98 =$ _____

6 $679 \div 112 =$ _____

7 $1{,}209 \div 65 =$ _____

8 $5{,}280 \div 37 =$ _____

9 $6{,}789 \div 1{,}083 =$ _____

10 $3{,}744 \div 156 =$ _____

Application problems

11 A truck delivering equipment to a distant job site travels 468 miles in 9 hours. At what speed is the truck being driven?

UNIT 2

12 A Cement Mason receives a gross paycheck of $1,800. This check represents 5 working days at 8 hours per day. How much is the Cement Mason paid per hour?

13 A large truck load of stone slabs weighs 21,812 pounds. There are 38 typical slabs on the truck. How much would each slab weigh?

14 A 40-piece bundle of $4 \times 4 \times 1/4" \times 10'$ angle weighs 2,400 pounds. How much would one angle weigh?

15 A starting apprentice needs 650 hours of work to become insured under the union's plan. How many complete 40-hour weeks will have to be worked before the apprentice is insured?

16 On a CMU building, there are 448 wall braces to be installed. If each of the 32 bays gets the same number of braces, how many braces are installed per bay?

17 Last year, a Pointer-Cleaner-Caulker made $42,600 working at a rate of $24 per hour. How many hours did he work last year?

18 An apprentice worked 9 days straight at the same location. According to the truck's odometer, the apprentice drove 774 miles. If the only driving was to and from work, how far was it to work (one way)?

19 The first floor pour of a job will require 220 cubic meters (a metric unit of measurement) of concrete. If a typical truck can carry 4 cubic meters of concrete, how many truckloads of concrete will need to be sent to this job?

20 There are 320,000 brick to be installed on a job, estimating that each bricklayer will lay 800 brick per day, how man-days will it take to complete the building?

UNIT 2

ASSIGNMENT SHEET 2.5

WHOLE NUMBERS

NAME:_____   SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Combined Operations with Whole Numbers

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

1 $38 \times 2 - 12 =$ _____

2 $14 \div (2 \times 7) =$ _____

3 $127 - 64 + 8 =$ _____

4 $5(6\text{-}2) + 17 =$ _____

5 $12 \div (2 + 2) + 14 =$ _____

6 $16 + 3 \times 8 =$ _____

7 $144 \div 12 - 10 =$ _____

8 $144 \div (12 - 10) =$ _____

9 $(47 + 3) \times 9 =$ _____

10 $(87 - 13 + 6) \div 5 =$ _____

11 $6(14 + 7 - 1) \div 6 =$ _____

12 $11 + 17 - 4 \times 5 =$ _____

13 $91 \div 7 + 6 \times 2 =$ _____

14 $4 \times 4 \div 4 + 4 =$ _____

15 $4 \times 4 \div (4 + 4) =$ _____

16 $256 - (32 \times 8) =$ _____

17 $(27 \div 3)(3 + 12) =$ _____

18 $216 \div (5 + 3) - 3 \times 7 =$ _____

19 $1 + 32 \times 7 - 16 =$ _____

20 $3(9 + 7 - 11) \div 5 =$ _____

Notes:

UNIT 3

COMMON FRACTIONS

OBJECTIVES

After completion of this unit, you should be able to solve mathematics problems involving the addition, subtraction, multiplication, and division of common fractions. This knowledge will be evidenced by correctly completing the Assignment Sheets and by scoring a minimum of 70% on the Unit Test.

Specifically, you should be able to:

1. Describe the fundamentals of common fractions.

2. Add common fractions.

3. Subtract common fractions.

4. Multiply common fractions.

5. Divide common fractions.

6. Perform combined operations with common fractions.

Each of these objectives is covered in the pages that follow.

Mathematics for BAC Craftworkers

ASSIGNMENT SHEET 3.1

COMMON FRACTIONS

NAME:_____ SCORE:_____ SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.
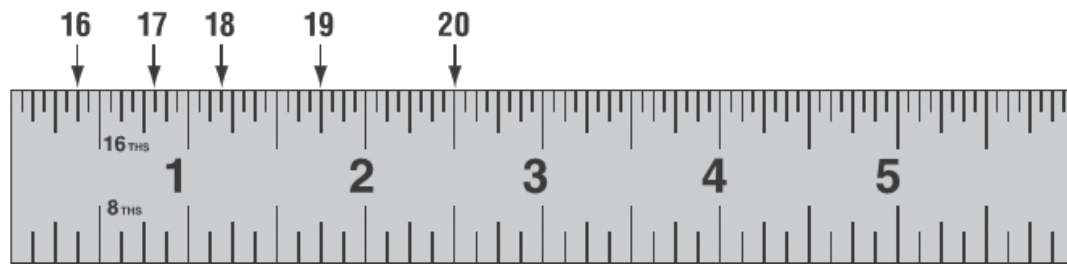
Fundamentals of Common Fractions

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 Convert $^7/_8$ to 32nds = _____

2 Convert $^{15}/_{16}$ to 64ths = _____

3 Convert $^3/_4$ to 16ths = _____

4 Convert 7 to 64ths = _____

5 Convert 16 to eighths = _____

6 Convert 1 to 32nds = _____

7 Convert $^{23}/_8$ to a mixed number = _____

8 Convert $^{49}/_{32}$ to a mixed number = _____

9 Convert $^{109}/_8$ to a mixed number = _____

10 Convert $1^{11}/_{16}$ to an improper fraction = _____

11 Convert $6^{27}/_{32}$ to an improper fraction = _____

12 Convert $4^{37}/_{64}$ to an improper fraction = _____

13 Convert $3^{11}/_{16}$ to an improper fraction in 32nds = _____

14 Convert $8^{21}/_{32}$ to an improper fraction in 64ths = _____

15 Express $^{24}/_{64}$ in lowest terms = _____

UNIT 3

Application problems

Instructions: For questions 16-20, use the following drawing of a ruler or scale. Determine the value of each measurement, and record this value in the blank space next to the corresponding number.

16 _____

17 _____

18 _____

19 _____

20 _____

ASSIGNMENT SHEET 3.2

COMMON FRACTIONS

NAME:_____ SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Addition of Common Fractions

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 $\frac{1}{4} + \frac{3}{8} =$ _____

2 $\frac{29}{32} + \frac{3}{4} =$ _____

3 $\frac{17}{64} + \frac{47}{64} + \frac{7}{8} =$ _____

4 $\frac{1}{8} + \frac{1}{16} + 2\frac{3}{64} =$ _____

5 $\frac{7}{8} + \frac{3}{8} =$ _____

6 $2\frac{1}{16} + 5\frac{3}{8} + \frac{3}{32} =$ _____

7 $11\frac{17}{32} + 12\frac{17}{64} =$ _____

8 $2\frac{1}{2} + 3\frac{5}{8} + 2\frac{9}{16} =$ _____

9 $\frac{9}{16} + 1\frac{3}{32} + 4\frac{57}{64} =$ _____

10 $7\frac{5}{8} + 3\frac{13}{32} + 1\frac{13}{4} + 2\frac{15}{16} =$ _____

UNIT 3

Application problems

11 The first masonry opening from end of building measures 1¾" to the jamb. Masonry opening A measures 35⅝", the next window jamb is located 40⅛" from masonry opening A and also is 35⅝". We will call this masonry opening B. What is the dimension of the furthest window jamb from the end of the building?

12 A bolt is needed to fasten three pieces of steel plate together for a granite job. To decide the length of the ¾" bolt, we have to consider that the three pieces of steel to be bolted together are $5/_{16}$", ¼", and $5/_{16}$" thick. The nut is ¾" thick, the washer is ⅛" thick, and the bolt should extend ¼" beyond the nut. What bolt length is needed?

13 A Tile Setter is laying out a decorative band of tile as an apprenticeship project. The first tile measures 7¾", the second tile measures 11⅝" and the third tile measures 15⅞". Taking in consideration there are $2^3/_{16}$" grout joints included, what is the total dimension of the band?

14 The perimeter is the distance around the outside of an object. Determine the perimeter of the plate in this figure.
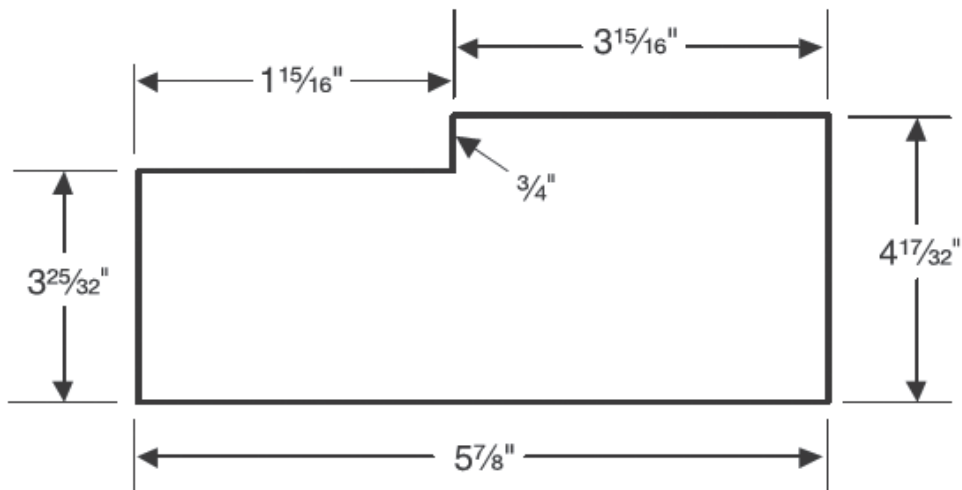
15 In the following figure, what is the length of the plate?
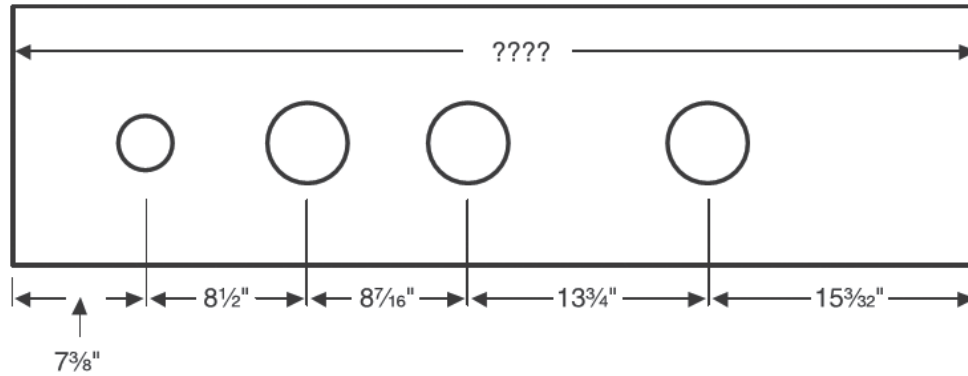
16 In question 15, how far from the left side of the plate is the center of the 3rd hole?

17 The typical top of floor elevation 144 ⅜". If a bar joist pocket is set on top of the first floor at 120 ½", what is the elevation of bar joist pocket?

18 If Jim works 7½ hours on Monday, 8¼ hours on Tuesday, 10¾ hours on Wednesday, 4¾ hours on Thursday, and 5½ hours on Friday, what is the total number of hours worked in this week?

19 What is the sum of the following weights? 6⅜ lbs, $12^{13}/_{16}$ lbs, $21^{11}/_{32}$ lbs

20 One corner of a unit is brought up to elevation by adding various thicknesses of shims. You add the following shims: ½", $^3/_{16}$", $^3/_{32}$", ¼". What is the thickness of the total shims?

UNIT 3

NAME:_____   SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Subtraction of Common Fractions

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.
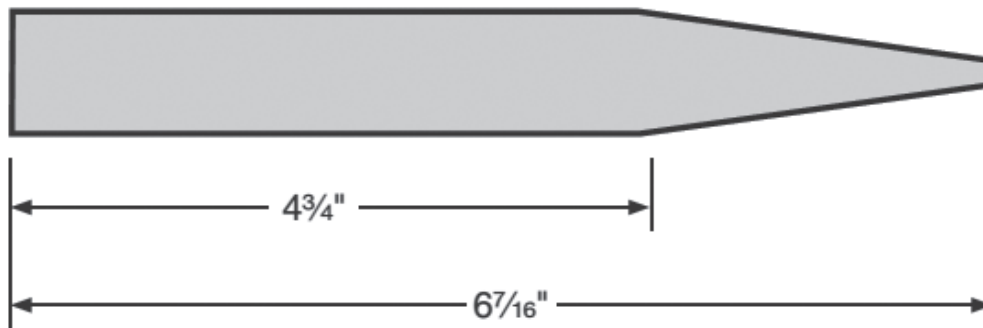
General problems

1 $\quad ^3/_8 - ^1/_8 =$ _____

2 $\quad ^{11}/_{32} - ^1/_8 =$ _____

3 $\quad ^{13}/_4 - ^{29}/_{32} =$ _____

4 $\quad 13^{57}/_{64} - 8^7/_8 =$ _____

5 $\quad 9^5/_8 - 8^{29}/_{32} =$ _____

6 $\quad 16 - 12^7/_8 =$ _____

7 $\quad 14^7/_{16} - 2^9/_{16} =$ _____

8 $\quad 14^{29}/_{32} - 7^1/_8 =$ _____

9 $\quad 4^5/_8 - 2^7/_8 =$ _____

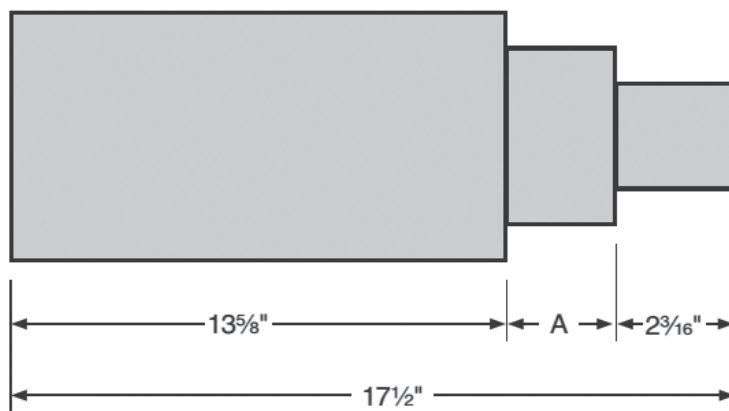**10** $\quad 23^{43}/_{64} - 19^{21}/_{32} =$ _____

UNIT 3

Application problems

11 A piece of angle measures $47^{15}/16"$ in length. There are 2 pieces, each measuring $8^5/8"$, cut from this angle. How long is the remaining piece?

**12** What is the length of the tapered part of the shaft in the following figure?

13 Determine dimension A in the following drawing.

14 A Terrazzo Mechanic is laying out zinc strips for a project. The total length of the project is 120 ¼". The four section project has 3 sections that are 29 ½". What is the length of the 4th section?

15 A benchmark of 4' (48") above finish floor is supplied for all the trades to use as a reference. If the bottom of window openings are 18 $\frac{1}{4}$" above finish floor, then how far below the benchmark will the bottom of the window opening be?

16 The top of wall height is 144 $\frac{7}{8}$", 2 pieces of marble are 46 $\frac{5}{16}$. Considering there are no grout joints in the project, what is the measurement of the 3rd piece of marble?

17 If a beam is a WF $\frac{137}{8}$ × 69, and the flange thickness is $\frac{11}{16}$", what is the depth of the web?

18 The outside diameter of a refractory pipe is 21 $\frac{3}{16}$". If the wall thickness is $\frac{29}{64}$", what is the inside diameter (ID)?
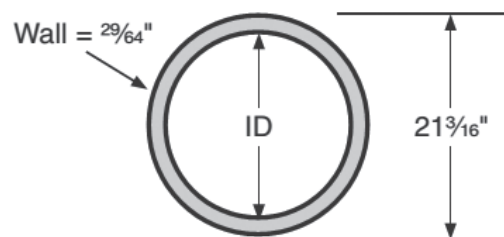
19 If a grout joint in a tile floor is ³⁄16" and the overall dimension if the tile layout including the joint is 13 ¾", what is the dimension of the tile?

20 What are the dimensions of the maximum size door that can be placed in an opening with dimensions 7'4" × 3'2" if $^3/_{16}$" clearance must be maintained between the door and the opening on all sides?

ASSIGNMENT SHEET 3.4

COMMON FRACTIONS

NAME:_____   SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Multiplication of Common Fractions

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 $7/8 \times 1/2 = $ _____

2 $11/16 \times 3 = $ _____

3 $4 \times 23/32 = $ _____

4 $2\frac{1}{8} \times 4^3/16 = $ _____

5 $3\frac{1}{8} \times 3\frac{1}{8} = $ _____

6 $3/4 \times 24 = $ _____

7 $\frac{1}{2} \times \frac{3}{4} \times 16 = $ _____

**8** $3^{19}/32 \times 2\frac{1}{2} = $ _____

9 $1^{15}/16 \times 2\frac{7}{8} = $ _____

10 $5\frac{3}{4} \times 2\frac{3}{8} \times 6\frac{1}{2} = $ _____

Application problems

11 A 55 gallon drum of epoxy resin is ⅝ full. How many gallons are in the drum?

12 A propane cylinder holds 300 cubic feet of acetylene. If only $1/7$ of the tank can safely be used per hour, how many cubic feet can be withdrawn from the tank per hour?

13 There are nine holes in a 6" wide thin tile that is 7' long. All the holes are in a line measuring $8^7/32$" from the center of one hole to the center of the next. What does it measure from the center of the first hole to the center of the last hole?

14 If each brick weighs 48¼ ounces, how many pounds would a cube of 500 brick weigh? (Note: 16 ounces = 1 pound)

15 A bundle of tile 6" wide × $5/16$" thick × 10' in length is delivered. If there are 15 tiles stacked in the bundle, how thick would the bundle be?

16 There are 32 risers (height of one step to the next) in a stair. If each riser is 7⁵/₈",
how tall is the stair?

Riser

Tread
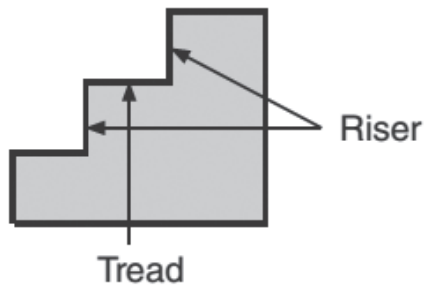
17 A 20' lintel is to be cut into 1'6" sections, producing 13 lintels. How much of the
lintel remains after cutting (assume no loss in the cutting process)?

18 A lanyard is stretched to ¹/₆₄ times its original length. If the initial length of the
lanyard is 32 feet, what is the stretched length?

19 A standard brick is 2¼" high. What is the total height of 13 standard bricks?
Assume they are laid dry with no mortar joints.

20 The construction of a building requires 3,124 square feet of brick work to veneer
the building. The sizes of the brick including mortar joints is equal to 6¾ brick per
square foot. Haw many bricks are need for the job?

ASSIGNMENT SHEET 3.5

COMMON FRACTIONS

NAME:_____ SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Division Of Common Fractions

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

General problems

1 $^3/_8 \div ^1/_8 =$ _____

2 $^7/_{16} \div ^3/_8 =$ _____

3 $^7/_8 \div ^3/_{16} =$ _____

4 $6^{19}/_{32} \div 3^3/_4 =$ _____

5 $12^5/_8 \div 4^{11}/_{16} =$ _____

6 $^1/_2 \div ^1/_4 =$ _____

7 $^3/_8 \div 1^5/_8 =$ _____

8 $2^1/_{16} \div 1^3/_{16} =$ _____

9 $4^{11}/_{16} \div 1^{17}/_{32} =$ _____

10 $6 \div 2^{11}/_{32} =$ _____

Application problems

11 On an architectural drawing $\frac{1}{4}$" equals 1 foot. How many feet are represented by 7½"?

12 The Bricklayer needs 100 pieces of angle, each to be cut $54\,\frac{3}{16}$" long. How many can be cut from a 20' length (do not include waste or thickness of cut)? How many pieces of 20' angle are needed in order to have the 100 pieces?

13 A flight of steps is 7'3" high. How many 7¼" risers are there in this flight of steps?

14 A Stone Mason can set one piece of large granite in $\frac{2}{3}$ hour. How many pieces can he set in 8 hours?

15 Find the number of 7½" risers required for a flight of terrazzo steps that is 4'4½".

16 On an architectural drawing ¾" represents 1 foot. How many feet are represented by 9"?

17 How many tiles would be needed horizontally for a floor that is 72'5¾" long? Each tile is 12¼" including the grout joint.

18 If a tile finisher can mix ½ of a cubic yard of mud in an hour, how many hours will it take him to make 14 cubic yards of mud?

19 John is plastering a wall. Each wall takes 6¼ bags of plaster. How many walls can John plaster with 31¼ bags of plaster?

20 The job that Joe, the apprentice, is working on is currently over budget by $1/_8$th of the original estimate. If the current total is $281,250.00, what was the original estimate?

UNIT 3

NAME:_____ SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Combined Operations with Common Fractions

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test. Your instructor will provide feedback regarding the correct answers.

1 $^{7}/_{16} + ^{3}/_{8} \times ^{1}/_{2} =$ _____

2 $1^{3}/_{16} \div ^{1}/_{16} + 2^{3}/_{4} =$ _____

3 $2 \left(3^{9}/_{16} + 2^{1}/_{8}\right) =$ _____

4 $\left(1^{1}/_{2} + 2^{1}/_{2}\right) \div ^{1}/_{4} =$ _____

5 $16^{3}/_{4} - 3^{1}/_{2} \times 2 =$ _____

6 $^{7}/_{8} + ^{5}/_{8} - ^{1}/_{4} =$ _____

7 $\left(6^{3}/_{4} + 2\right) - 5^{1}/_{8} =$ _____

8 $^{3}/_{8} \times 1^{1}/_{2} + ^{1}/_{2} =$ _____

9 $^{5}/_{8} \times ^{5}/_{8} + ^{5}/_{8} =$ _____

10 $^{5}/_{8}\left(^{5}/_{8} + ^{5}/_{8}\right) =$ _____

11 $2^{1}/_{4} + \left(3 \times 2^{1}/_{2}\right) - 1 =$ _____

12 $12 - 14 \times ^{1}/_{4} =$ _____

13 $\left(11^{1}/_{4} \times 6\right) \div 2^{1}/_{2} =$ _____

14 $8 + ^{3}/_{64} \times 8 =$ _____

15 $7^{7}/_{8} \div ^{1}/4 + 3^{1}/_{2} =$ _____

16 $\left(4^{1}/_{2} \times 2\right) \div 2^{1}/_{2} =$ _____

17 $^{3}/_{4}\left(6^{1}/_{2} + 2^{3}/_{4} + 4^{1}/_{4}\right) =$ _____

18 $5^{7}/_{16} + 2 \times 3^{3}/_{8} =$ _____

19 $12^{3}/_{4} \div ^{1}/_{8} + 14^{1}/_{2} =$ _____

20 $25 - 3^{3}/_{4} + ^{1}/_{2} \times 12 =$ _____

UNIT 4

OBJECTIVES

After completion of this unit, you should be able to solve mathematics problems involving the addition, subtraction, multiplication, and division of decimal fractions. This knowledge will be evidenced by correctly completing the Assignment Sheets and by scoring a minimum of 70% on the Unit Test.

Specifically, you should be able to:

1. Use a calculator to add, subtract, multiply, and divide whole numbers and decimal fractions.

2. Describe the fundamentals of decimal fractions.

3. Add decimal fractions.

4. Subtract decimal fractions.

5. Multiply decimal fractions.

6. Divide decimal fractions.

7. Perform combined operations with decimal fractions.

Each of these objectives is covered in the pages that follow.

ASSIGNMENT SHEET 4.1

DECIMAL FRACTIONS

NAME:_____   SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Fundamentals of Common Fractions

Instructions: Solve each of the following problems. Note that you should complete this Assignment Sheet without the aid of a calculator, as you will not be able to use a calculator on the Unit Test.

Use the number 0.146793 to answer items 1-6.

1 What is the value of the number in the thousandths place?

2 What is the value of the number in the tenths place?

3 What is the value of the number in the hundred-thousandths place?

4 What is the value of the number in the millionths place?

5 What is the value of the number in the hundredths place?

6 What is the value of the number in the ten-thousandths place?

7 Express 19/100 as a decimal fraction.

8 Express ¼ as a decimal fraction to 2 decimal places.

9 Express 7/8 as a decimal fraction to 3 decimal places.

10 Express 7/16 as a decimal fraction to 4 decimal places.

11 Express 15/16 as a whole number and decimal fraction to 4 decimal places.

12 Express 3/10 as a decimal fraction.

13 Express 43/20 as a whole number and decimal fraction to 2 decimal places.

14 Express 63/4 as a whole number and decimal fraction to 2 decimal places.

15 Express 133/1000 as a decimal fraction to 3 decimal places.

16 Round 0.63859 to the nearest thousandth.

17 Round 0.63859 to the nearest tenth.

18 Express 5.6 as a whole number and common fraction.

19 Express 4.625 as a whole number and common fraction.

20 Express 11.0625 as a whole number and common fraction.

NAME:_____   SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Addition of Decimal Fractions

General problems

1 2.395 + 6.17 =   _____

2 12.706 + 3.94 = _____

3 9.02 + 6.38 + 11.57 = _____

4 0.3875 + 0.648 = _____

5 126.392 + 145.047 = _____

6 49.358 + 24.524 + 26.118 = _____

7 16.083 + 27.009 = _____

8 0.349407 + 0.687304 = _____

9 37.7845 + 46.06 = _____

10 89.125 + 110.875 = _____

Application problems

11 An apprentice received an hourly raise of $1.49. If he was earning $17.85 per hour, how much will he be earning after the raise?

**12** A BAC contractor is bidding a job that has $5,786.45 in materials, $4,378.20 in labor and overhead of $452.50. If a profit of $1,097.27 is desired, what would be the contractor's bid?

UNIT 4

13 The first floor reference is 183.29' above sea level. From the first floor to the second floor, it measures 28.75' and then another 12.5' to the third floor. How far above sea level is the third floor?

14 An expense report for one week is itemized as: $9,275.24 for materials, $7,899.65 for labor and $796.22 for overhead. What is the total expense for the week?

15 The perimeter of an object is the distance around the outside edges of the object. What is the perimeter of this object?
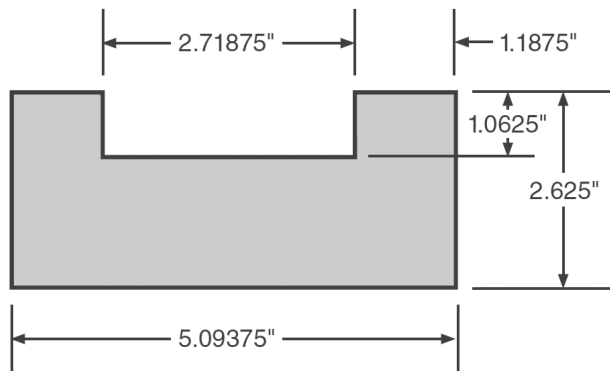
16 The diameter of a circle is the distance from one outside edge to the other outside edge going through the center of the circle. What is the outside diameter of this pipe if the thickness of the pipe wall is 0.625"?
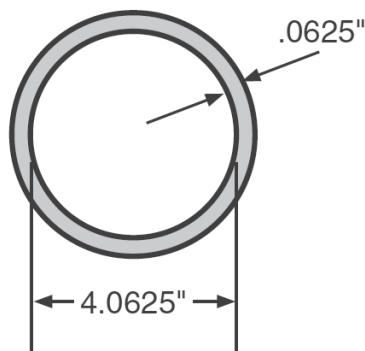
17 A bricklayer is building a fireplace and pays $363.90 for firebrick, $1,063.97 for face brick, $123.90 for sand, $345.87 for cement and $236.98 for flue liners. What was the total cost of the materials?

18 An apprentice wants to take two old water drums and put them into one empty drum. If the two volumes are 24.375 liters and 27.870 liters, then what will be the volume in the third drum?

19 Earl, the apprentice, is taking the coffee order, and Joe, the foreman, gives him $20 for the following list of items and says, "Keep the change, kid." Find the total amount of change to determine whether or not Earl can retire early.

- 1 XL double = $1.37
- 1 L cream = $1.24
- 1 M black = $1.19
- 1 Gatorade = $ 2.24
- 1 Boston cream = $0.46
- 1 tuna sandwich = $2.43
- 1 club sandwich = $3.09
- 1 toasted western = $2.77
- 6 candy bars = $5.21

20 What is the thickness of the following stack of shims? 0.045 cm, 0.015 cm, 0.235 cm, 0.175 cm.

ASSIGNMENT SHEET 4.3

DECIMAL FRACTIONS

NAME:_____   SCORE:_____

Directions: Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Subtraction of Decimal Fractions

Instructions: Solve each of the following problems. Your instructor will provide feedback regarding the correct answers.

General problems

1 0.176 – 0.098 = _____

2 1.306 – 0.846 = _____

3 18.007 – 15.816 = _____

4 24.24 – 18.18 = _____

5 132 – 103.19 = _____

6 5.018 – 4.6528 = _____

7 16.2 – 14.87 = _____

8 650.258 – 387.62 = _____

9 0.74786 – 0.65897 = _____

**10** 104.85 – 98.906 = _____

Application problems

11 A third year apprentice is earning $20.80/hr. How much more is the apprentice making than the first year apprentice who is earning $14.85/hr?

12 A BAC member has $625.25 in his checking account. A check is written for $295.62. What is the balance of the account?

13 The overall height of a column is 167.25". The column is composed of marble and has a granite base that is 36.75". What is the dimension of the marble excluding the base?

14 A bid of $25,678.97 is made for a job. If $7,343.11 is allowed for materials and $12,765.09 for labor, how much is allowed for overhead and profit?

15 Find the dimension of side A in the following figure.
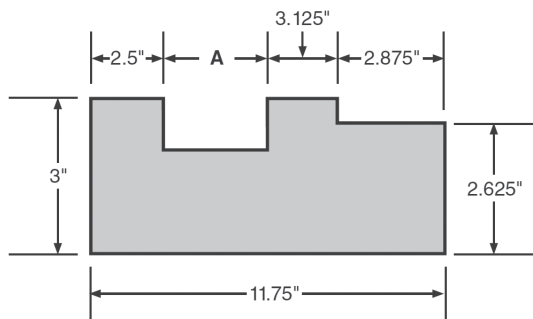
16 The following figure is an end view of a turned metal shaft. What is the diameter of the smallest circle?
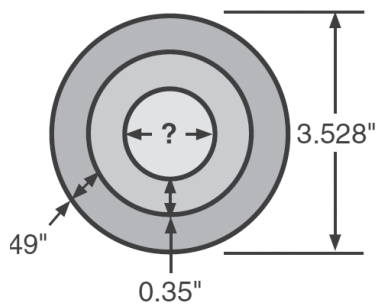
17 An apprentice usually makes $1,008.47 during a 40-hour week. This week, he was mistakenly given a payroll check for $238,122.66. How much will he be charged with defrauding the company if he cashes this check?

18 A terrazzo mechanic's tools were stolen from his truck. The terrazzo worker was given $1,235.75 from his insurance company for his losses. With the insurance money he bought a used base grinder for $925.00 and other miscellaneous tools for $425.50. What was his out of pocket expense at the end of the day?

19 A BAC tile contractor bids a job at $23,153.25. The floor leveling cost the contractor $8,284.15 and the tile work cost $12,345.65. What was the total profit on the job?

20 A stone mason is setting granite slabs using 1/8" (3.2mm) and 1/16" (1.6mm) shims. If the stone mason used 3 – 1/16" and 1 – 1/8" shims and the finished height is 1628mm, what is the nominal dimension of the slab in mm?

ASSIGNMENT SHEET 4.4

NAME:_____   SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Multiplication of Decimal Fractions

General problems

1 $19.37 \times 2.6 =$ _____

2 $8.4 \times 5.06 =$ _____

3 $27.28 \times 7.7 =$ _____

4 $16.3 \times 0.88 =$ _____

5 $0.36 \times 0.6 =$ _____

6 $9.1 \times 0.07 =$ _____

7 $8.5 \times 2.5 =$ _____

8 $13.99 \times 0.3 =$ _____

9 $0.75 \times 12 =$ _____

10 $11.8 \times 6.2 =$ _____

Application problems

11 Wages are $25.72 per hour. What is the gross pay for a week where 38 hours straight time are worked and 9 hours at double time?

12 A 4 × 4 angle 0.75" thick weighs 18.5 lbs. per linear foot. If it measures 9.75' in length, what is the total weight of this angle?

13 What is the circumference of a circular brick column that measures 2.5' in diameter? (Circumference = pi × diameter and pi = 3.14).

14 Six bar joists pockets are spaced equally at 72.375" center-to-center between each pair of joists. What is the total dimension from the center of the first bar joist to the last bar joist? (Hint: You may want to draw a sketch before making the calculation.)

15 There are 1,750 granite anchors packaged on a skid. Each bolt weighs 0.3125 lbs. What is the total weight of bolts on the skid?

16 If a brick is 2.25" high, how high in inches is a stack of 26 bricks?

17 One gallon of grout weighs 8.75 lbs. An empty 50 gallon drum weighs 36.5 lbs. What is the weight of the 50 gallon drum once it is filled with grout?

18 Eight BAC Plasterers work on a job for 7.25 hours. What is the total number of hours spent on this job?

19 Ceramic tile weighs 4.25 pounds per square foot. Calculate the weight of 138 square feet of ceramic tile.

20 A BAC Cement Mason is pouring a small porch that requires 12 pieces of #3 rebar 3 feet long. If the rebar weighs 0.38 lbs. per foot how much do the 12 pieces weigh?

UNIT 4

ASSIGNMENT SHEET 4.5

NAME:_____ SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Division of Decimal Fractions

General problems

1 $6 \div 0.012 =$ _____

2 $1.8 \div 3 =$ _____

3 $3.6 \div 0.4 =$ _____

4 $16 \div 2.5 =$ _____

5 $72 \div 0.09 =$ _____

6 $14.4 \div 36 =$ _____

7 $0.96 \div 3 =$ _____
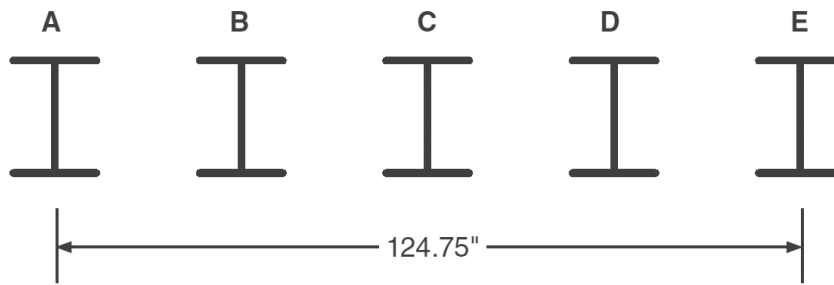
8 $0.42 \div 0.07 =$ _____

9 $22.1 \div 1.3 =$ _____

10 $26.195 \div 6.5 =$ _____

Application problems

11 A BAC Craftworker worked 37.5 straight time hours. The check totaled $964.50. What was the hourly pay?

UNIT 4

---

12 The following column centers are equally spaced. What is the distance from the center of column A to the center of column B? ILLUSTRATION

A   B   C   D   E

|←——————————— 124.75" ———————————→|

13 Using the same column centers, what is the distance from the center of column E to the midpoint between columns B and C? ILLUSTRATION

A   B   C   D   E

|←——————————— 124.75" ———————————→|
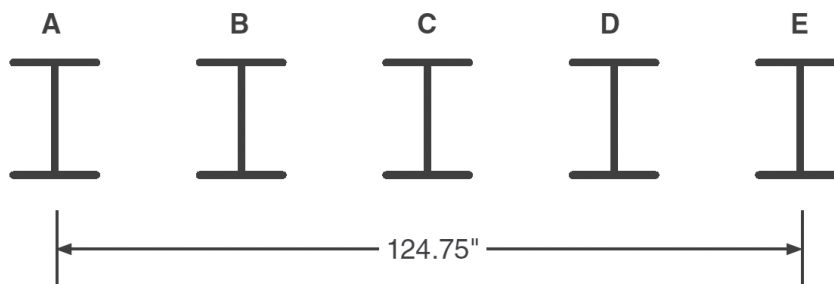
14 Three BAC PCC Craftworkers caulk a total of 1240 lineal feet of ½" expansion joint on a hospital job. If on average a 20 oz. caulk gun can caulk 15.5 lineal feet of ½" expansion joint, how many ounces of caulk was needed?

15 A stack of brick is 22.5 inches high, if each brick is 2.25 inches high. How many bricks are in the stack?

16 The BAC member's pension plan pays $15.20 as a monthly retirement amount for every $1,000.00 that is paid into the plan on behalf of the member. If an apprentice swears in as a journeyman with $229.00 in the plan for their monthly amount, how many dollars in pension has the apprentice actually earned to this point?

17 To determine the estimated load on which to base a rule of thumb calculation for hoisting with wire rope cable clamps, the Marble apprentice must divide the load by the efficiency of the sling. If the load is 15.5 tons and the efficiency is 75% (0.75), then what is the estimated load on which to base the choker size?

18 To convert metric measure to imperial (meters to inches), the amount measured in meters must be divided by 0.0254 to produce the appropriate number of inches. You measure 1.256 meters and wish to know the equivalent decimal inch amount. What will it be?

19 A BAC apprentice in the United States talks to the Apprenticeship Coordinator and gets a clearance letter to work in a Canadian local. If the Canadian dollar is worth 73.2 cents American ($0.732), and the apprentice is looking to change $500 American into Canadian dollars, what will the apprentice get?

20 A BAC Canadian apprentice is working on a job and is given a shop print, which has all of the dimensions in imperial measurements. Since the apprentice is used to working in metric, the apprentice needs to change the weight per unit measure into the metric equivalent. If the stone slab in question weighs 104 lbs per foot and the conversion is to divide by 1.4885, what is the equivalent measure in kg/m?

UNIT 4

NAME:_____   SCORE:_____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

Combined Operation with Decimal Fractions

1 $5.7 + (3.8 \times 2.5) =$ _____

2 $6(4.8 + 3.7) - 12 =$ _____

3 $12.14 \div 0.2 - 54.2 =$ _____

4 $7.64(1.6 + 2.3 - 1.7) =$ _____

5 $(1.5 \times 16) \div 2.5 =$ _____

6 $8(4.6 + 3.2) \div 1.2 =$ _____

7 $12 \times 0.6 \times 8.5 - 14.8 =$ _____

8 $13.75 + 12.25 \times 1.5 =$ _____

9 $22 \div 1.6 + 3.8 \times 2 =$ _____

10 $18 - (3.6 \times 2) + 5.3 =$ _____

11 $(42 \div 5.6)4.5 - 12 =$ _____

12 $0.18 + 1.4 \times 2.6 - 0.75 =$ _____

13 $15.75 \times 3.86 - 1.472 =$ _____

14 $16 - 2.5 \times 3.9 \times 0.8 =$ _____

15 $11.12 \times 5 + 51 =$ _____

16 $6.5 \times 6.5 + 6.5 =$ _____

17 $6.5(6.5 + 6.5) =$ _____

18 $4.5(1.6 \div 0.32) - 4.5 =$ _____

19 $(2.85 + 1.15)7.4 =$ _____

20 $3.8(11.7 - 2.3 + 1.6) =$ _____

UNIT 4

UNIT 5

OBJECTIVES

After completion of this unit, you should be able to solve mathematics problems involving linear, area, circular, and volume measurement. This knowledge will be evidenced by correctly completing the Assignment Sheets and by scoring a minimum of 70% on the Unit Test.

Specifically, you should be able to:

1. Solve linear measurement problems.

2. Solve area measurement problems.

3. Solve circular measurement problems.

4. Solve volume measurement problems.

Each of these objectives is covered in the pages that follow.

ASSIGNMENT SHEET 5.1

MEASUREMENT

NAME: **SCORE:**

> **Directions:** Answer each of the following questions based on the information presented in the unit. You will need a ruler or scale to complete this Assignment Sheet. The ruler or scale must be marked to read 16ths of an inch. Round calculated answers to 2 decimal places unless otherwise indicated. Your instructor will provide feedback regarding the correct answers.

General problems

1 Convert 25.5' to feet and inches. _____

2 Convert 13.417' to feet and inches. _____

3 Convert 36'9" to feet and inches as a decimal fraction. _____

4 Convert 8'7½" to feet and inches as a decimal fraction (to 2 decimal places). _____

5 Measure the following line with a ruler or scale and record the length. _____

_____

6 Measure the following line with a ruler or scale and record the length. _____

_____

7 Measure the following line with a ruler or scale and record the length. _____

_____

8 Measure the following line with a ruler or scale and record the length. _____

_____

9 Measure the following line with a ruler or scale and record the length. _____

_____

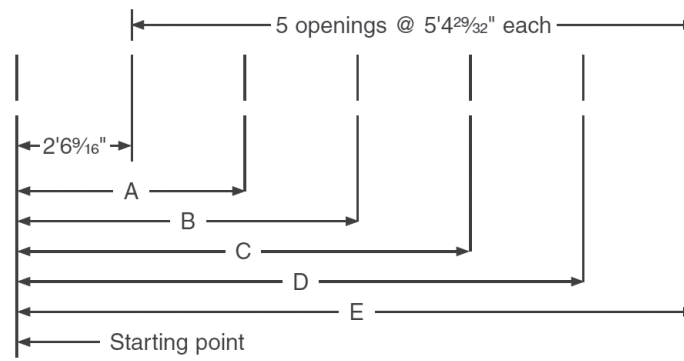**10** Measure the following line with a ruler or scale and record the length. _____

_____

UNIT 5

11 $7'1^{15}\!/16" + 12'6^{1}\!/4" =$ _____ (as common fractions)

12 $36'3^{11}\!/32" - 24'6^{11}\!/16" =$ _____ (as common fractions)

13 $7^{3}\!/8" \times \frac{7}{8}" =$ _____ (as a decimal fraction to 2 places)

14 $14'5^{5}\!/8" \div 23^{5}\!/16" =$ _____ (as a decimal fraction to 2 places)

15 $6'4^{3}\!/8" \times 15^{11}\!/16" =$ _____ (in square feet as a decimal fraction to 2 places)

Application problems

16 A terrazzo floor plan calls for divider strips to be set from left to right at 10.25', 9.75', and 8.75'. Find the total length of the floor and give the answer in feet and inches.

17 If the apprentice wishes to cut a 20-foot section of angle in seven identical lengths, what will the measurements be in fractional inches to the nearest $\frac{1}{32}"$ (assuming zero loss of metal due to cutting)?

18 What is the length (in feet and inches to the nearest $\frac{1}{8}"$) of the longer side of a rectangle with a width of $2'6^{1}\!/2"$ if the area is 36.247 square feet?

19 Six refractory anchors must be laid out equal distance apart on a 16-foot slab furnace ceiling. What is the distance (in feet and inches to the nearest ⅛") between any two of the clips? (Hint: draw a picture of this problem.) Note: there will be a clip at both ends of the ceiling.

20 Refractory anchors have to be welded per the drawing below. The apprentice is holding the tape measure at the starting point, while the layout foreman is marking the accumulative measurements. What are the measurements for A, B, C, D, and E?

```
        |←————— 5 openings @ 5'4²⁹⁄₃₂" each ————→|

  |←2'6⁹⁄₁₆"→|
  |————— A —————|
  |———————— B ————————|
  |——————————— C ———————————|
  |—————————————— D ——————————————|
  |————————————————— E —————————————————|
  |——— Starting point
```

21 Give the dimensions from column center to the center of each of the anchor bolts marked A, B, and C in this 12" channel.
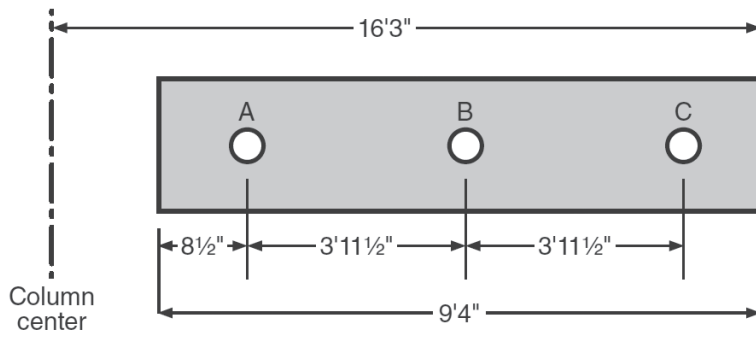
22 An apprentice measures 8'8" from the first hole to the last of 8 equally spaced holes. What is the center-to-center dimension as a decimal fraction from one hole to the next?

UNIT 5

23 A BAC Craftworker needs 14 angles measuring 1'4 3/16" each. If these are to be cut from a single stock length, what is the minimum length of angle needed (ignore waste due to cuts)?

24 In a concrete floor, 19 control joints are equally spaced. From the center of the first beam to the center of the last control joint, it measures 204.75'. What is the center-to-center spacing between the control joints?

ASSIGNMENT SHEET 5.2

MEASUREMENT

NAME: _____   SCORE: _____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Round calculated answers to 2 decimal places unless otherwise indicated. Your instructor will provide feedback regarding the correct answers.

General problems

**1** One side of a square measures 7". What is the perimeter? The area?
_____

2 What is the area in square feet of a rectangle that measures 2'7" by 3'9"? What is the area in square inches? _____

3 Find the area in square inches of a rectangle that measures 1'8" × 9".
_____

4 Find the area in square feet of a rectangle that measures 18" × 4'11".
_____

5 A square panel measures 11.6" on one side. What is the area in square feet?
_____

6 The base of a triangle measures 16". The height of the triangle is 34". What is the area? _____

7 What is the area in square feet of a parallelogram that has a length of 2'7" and a height of 1'3"? _____

8 A trapezoid has one base measuring 18', and the other measuring 13'8". What is the area if height of the trapezoid is 11'4"? _____

9 The design for a building calls for a series of solid triangles as part of the entrance. One of these triangles is 8'6" in height and has a base that measures 4'9". Another triangle has the same size base but is 2 feet shorter than the other. What is the combined area of these two triangles? _____
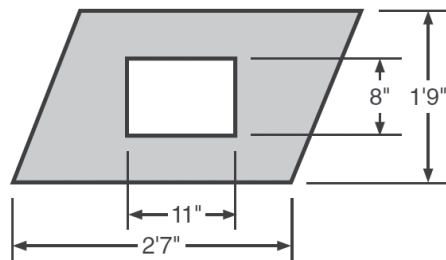
10 What is the area of this piece of object?
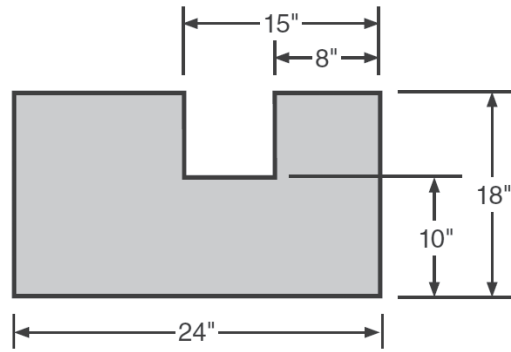
11 Calculate the area of this surface that has a 3" × 3" square hole cutout.
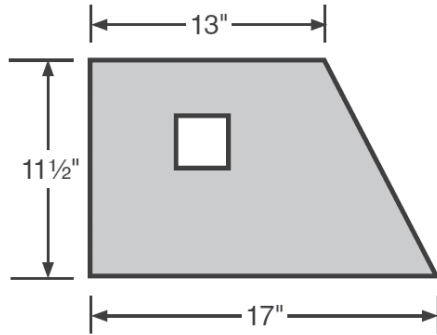
12 Calculate in square feet the area of this parallelogram after the rectangular cutout has been removed.

Application problems

13 What is the area of granite slab that will be needed to fabricate a planter (with no top) that has a square base measuring 4'6" and is 3' high?

14 A BAC tile setter apprentice is laying tile and looks at the blueprints. The tile setter must reinforce any damaged areas more than 225 sq. cm with isolation membrane. If the tile setter finds a damaged area that measures 15.5 cm by 13 cm, will it require reinforcing?

15 A typical marble panel on a soffit job measures 4' × 1'6". The underside of the soffit to be installed measures 8' wide by 17' long. How many panels will the job require, and what will the dimensions of the field fit panels be (if any are required)?

16 In order to place an order for concrete, the cement mason apprentice is told to figure out the square footage of an area with the following dimensions (it will be helpful to first sketch this problem):

▶ From the square corner of the pour stop (N/W corner) to the bulkhead along the east-west line, it measures 17'6"

▶ From the square corner of the pour stop (N/W corner) down to the bulkhead along the north-south line, it measures 22'4"

▶ The measurement of the bulkhead at this point to where it meets the other bulkhead is 14'6", and:

▷ This bulkhead runs parallel to the pour stop on the east-west line.

What is the square footage of the pour?

17 A typical deck section measures 32" by 24'. How many sheets will be needed to cover a box building that is approximately 150,000 square feet?

18 The outside face of a glass block curtain wall measures 120' wide × 212' tall. If one-third of the glass blocks are opaque, how many square feet of glass block are clear vision glass?

19 Jobsite specifications state that no more than 3,000' square feet of tile can be laid before it has to be grouted. If the tile is being laid between Lines A and B in this diagram, how many bays can be set before grouting the floor?
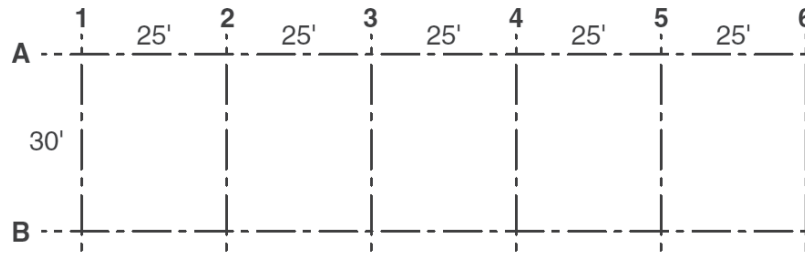
20 What is the weight of an angle 6" × 6" × ½" that is 18' long? (Note that 1" thick steel weighs approximately 40 lbs per square foot.)

21 Pictured below is a map of a local union's jurisdiction. If there are 3 business agents splitting the area, how many square miles would each business agent have to cover?

50 miles

100 miles

35 miles
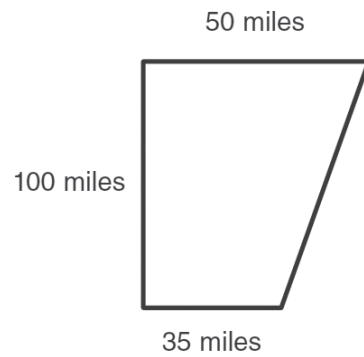
22 Wire mesh is being laid on the third floor before the concrete is to be poured. If the floor measures 112' × 75', how many square feet of mesh is needed?

ASSIGNMENT SHEET 5.3

MEASUREMENT

NAME: _____ SCORE: _____

> **Directions:** Answer each of the following questions based on the information presented in the unit. Your instructor will provide feedback regarding the correct answers.

General problems

1 The diameter of a circle is 14⅝". What is the radius? _____

2 The radius of a circle is 7'8¹¹/₁₆". What is the diameter? _____

3 The diameter of a circle is 2⅜". What is the circumference as a mixed number with a decimal fraction to 2 decimal places? _____

4 The radius of a circle is 11.8'. What is the circumference to 2 decimal places? _____

5 Convert 45° to seconds. _____

6 Convert 15° 30' to minutes. _____

7 Convert 15,238" to degrees. _____

8 The diameter of a circle is 10'. What is the area in square feet to 2 decimal places? _____

9 The radius of a circle is 3'7½". What is the area in square feet as a mixed number with decimal fraction to 2 decimal places? _____

Application problems

10 A wet saw sits in the middle of a work area. The length of the electrical cord is 8'. If the BAC Craftworker can move around the machine in a circle, what is the area of that circle to 2 decimal places? _____

11 The BAC Craftworker apprentice is determining the weight of a circular piece of marble that measures 4'6" in diameter. What is the area of the marble?

UNIT 5

12 If a BAC Craftworker apprentice sets up an instrument to swing arcs and each arc measures 21 degrees, 10 minutes, and 35 seconds; how many arcs will the apprentice be able to layout before returning to the baseline?

13 A stock piece of granite 4' x 8' needs to have three circular rings cut out of it that are 2" wide and have an inside diameter of 2'. How many square feet of granite will remain after cutting (including the cutouts)? (Hint: Draw a picture first.)

14 An apprentice has to install insulating block around the inside of a kiln section. How many 8" wide block will be needed if the outside diameter of the kiln shell is 18'3", and the vessel thickness is 11/8"?

15 What is the spacing (around the circle) between 8 tapcons spaced equally around a marble interior column that has a diameter of 9" if the tapcons are set-in 1" from the edge of the marble? (Hint: Draw a picture first.)

16 Terrazzo is being installed on the basement floor of a church. The building is round and measures 102' across. How many square feet of terrazzo will be needed?

UNIT 5

17 A welder welding hex mesh in a refinery switches from a 1/8" diameter rod to a 3/16" diameter rod as shown below. By what percent has the surface area increased?

⅛"   ³⁄₁₆"

18 The layout foreman is using the transit to turn an angle to the left of 45° 20' 30". The transit being used only gives readings in the clockwise direction. Subtracting from 360°, what reading will the instrument be turned to?

19 A column joint has to be caulked the total perimeter of the 18" diameter column. How many inches of caulk will it take to caulk the total perimeter of the column?

20 A crane is being used to lower a load into a hole. When the load is at ground level, the operator says there are 10 wraps of cable left on the drum of the crane that can be used to lower the load. If the drum is 23" in diameter, how many feet down can the load be lowered below ground level?

ASSIGNMENT SHEET 5.4

MEASUREMENT

NAME: SCORE:

> **Directions:** Answer each of the following questions based on the information presented in the unit. Round calculated answers to 2 decimal places unless otherwise indicated. Note that if you use 3.14 for the value of pi (π) instead of letting your calculator use the value for pi that has not been rounded, your answers will differ slightly from those of your instructor. Your instructor will provide feedback regarding the correct answers.

General problems

1 Convert 3.8 cu ft to cubic inches. _____

2 Convert 34,685.46 cu in to cubic feet. _____

3 Convert 15.75 cu yd to cubic feet. _____

4 Convert 1.7 cu yd to cubic inches. _____

5 Convert 18.93 pints to quarts. _____

6 Convert 183.37 gal to cubic inches. _____

7 Convert 0.85 qt to gallons. _____

8 Convert 18,362.27 cu in to gallons. _____

Application problems

9 A cube measures 15" on one edge. What is the volume of the cube?

10 A rectangular block of metal measures 6½" × 3" × 4¾". What is the volume of the block as a mixed number with a decimal fraction to 2 decimal places?

UNIT 5

11 A container measures 4'6⅜" × 2'11" × 1'7¾". Approximately how many gallons of water will this container hold?

12 The tank in this figure is 75% full of fuel. How many gallons of fuel are in the tank?


Height = 3'6"

Width = 4'

Length = 6'
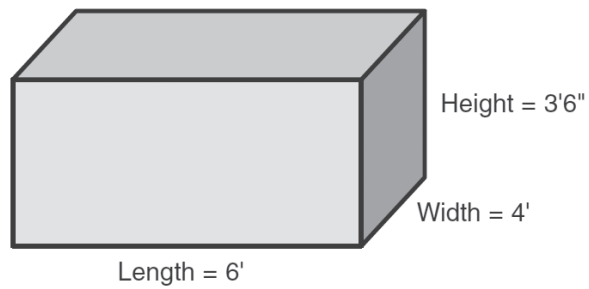
13 A pad measures 32' × 24'. The concrete to be poured in the pad will be 6" thick. How many cubic yards of concrete are required for the pad?

14 What is the volume of this cylinder tank (in cubic feet)?

Radius = 12'

Height = 8'6"
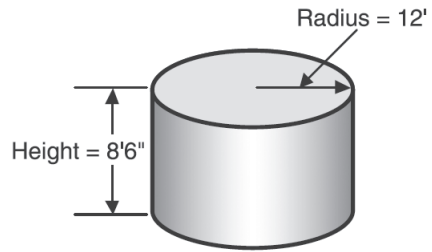
15 The tank in the previous problem is 90% full of water. How many gallons of water would need to be added to fill the tank?

16 What is the volume to two decimal places of a triangular bottomed bin that has 3 equal sides, each measuring 2.335 m with a midpoint length of 2.022 m and walls that are 3 m high? The following figure shows the bottom of the bin.
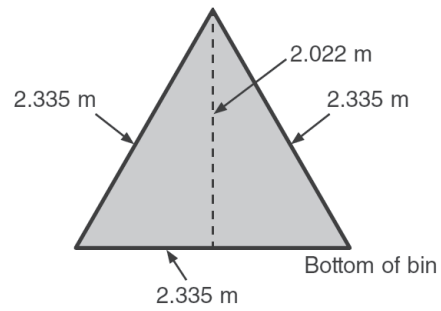
17 What is the volume (in cubic feet) of the **plate** in a circular vessel that measures 20' in length, has an outside diameter of 4'6" and a wall thickness of ⅝"? Note: the vessel is open on both ends.

18 How many cubic feet of water are in a barrel with a diameter of 3'6" and a height of 4' if it is filled to the 3'8" level?

19 How many times larger will the volume be in a granite cubic ingot if the dimensions are tripled?

20 A BAC Craftworker apprentice just graduated to the 90% wage level and can now afford a back yard pool. He needs to dig a sizable hole to place an in-ground pool in the yard. If the dimensions of the hole are 8 m × 4 m × 3.75 m deep, and the bucket on the bobcat he rented holds 3 cubic meters, how many trips will he have to make to finish?

21 The welding shop at the apprentice school measures 18' wide 75' long × 14' tall. A new exhaust system was installed that exhausts 7400 cubic feet of air per minute (CFM). How long will it take to exhaust the whole shop?

22 There are 18 column forms to be filled with concrete. The columns are 24" in diameter and are 12' tall. How many cubic yards of concrete are needed to fill all 18 forms?

23 A coffer dam 24' in diameter and 14' deep needs to be pumped out. How long will it take to pump the water out if the pump being used will pump 1,100 gallons per hour?

24 The crane's steel counter weight measures 8'9" × 4' × 3'6" high. If one cubic foot of steel weighs 480 lbs, how much does the counter weight weigh?

25 How much does a crane's 24" headache ball weigh if one cubic foot of steel weighs 480 lbs? (Use the formula for volume of a sphere: V = ⁴⁄₃ × π × radius cubed.)

UNIT 5