The outline of mathematics skills provides for individualized instruction by allowing each student to complete performance tests which indicate the point at which his instruction should start. The course is divided into two parts; one covering operations with whole numbers, decimals, fractions, and percentage; the other dealing with ratio, proportion, square roots, fundamental geometry, and trigonometry with practical applications. The skills in part one are prerequisite to successful completion of part two which meets the performance requirements of the second class machinist classification. The outline contains lists of texts for both parts on which the skills and assignments are based and a pretest for proficiency credit for part one. The course is structured in units (13 in part one, 10 in part two) which are divided into lessons. For each lesson specific performance objectives with corresponding assignments from the texts are indicated. Quizzes for some lessons and tests for each unit (actual forms) are included. An evaluation form for each unit has space for lesson, quiz, and unit test grades and a percentage formula for using these three types of scores in tabulating a final grade. (MS)
APPLIED MATHEMATICS - MACHINE SHOP

A Teachers Guide

Behavioral Objectives
Individualized Curriculum

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INTRODUCTION

MACHINE SHOP
APPLIED MATHEMATICS I

The following is a performance outline for Machine Shop Mathematics I. Each student must demonstrate a capability in all the performances listed to complete the course. These math skills will equip the student to make the necessary calculations for machine tool operation, for personal needs, and as a prerequisite to Machine Shop Mathematics II.

The outline is constructed for individual instruction. All students will start the course by completing tests until they reach their present level of performance. Each individual's instruction will start at that point and continue until he has mastered the performances outlined. Completion of this course of study will permit the student to pursue Machine Shop Mathematics II or take the option of other electives.

Much of the learning will be under the student's own direction. His progress will depend largely on his personal effort and ability. Each class member is expected to give his best effort, using class time to maximum advantage. The benefit each student receives from the instructor's guidance, advice, and knowledge will depend to a large degree on a mature attitude on the part of each individual and the class as a whole.

The student must be convinced that the level of his math skills will have a direct impact on his shop progress. The Machine Shop course relies strongly on knowledge of math and other related subjects. Specific shop performance requirements cannot be met without these background courses.

This course should be an easy step-by-step learning process that should be easily mastered by the conscientious and able student. When he has mastered his related and shop skills, he will be recommended for a trial "earning" in the trade. Remind the students: "You 'learn so that you may earn'".
REFERENCE MATERIALS
FOR
COURSE OF STUDY OUTLINE
MACHINE SHOP
APPLIED MATHEMATICS I

1. Basic Mathematical Skills (BMS)
   Loyce C. Gossage
   McGraw-Hill Book Company

2. Mathematics for Technical and Vocational Schools
   Stade, Margolis & Boyce
   John Wiley and Sons, Inc.

3. Basic Vocational Mathematics I
   C. M. Santoli
   Vocational-Technical Curriculum Laboratory
   Rutgers - The State University

4. Essential Business Mathematics (EBM)
   Llewellyn R. Snyder
   McGraw-Hill Book Company

5. Business and Consumer Arithmetic (B&CM)
   Olson and McNelly
   Prentice Hall, Inc.
PRETEST

Machine Shop Applied Mathematics I

NOTE TO STUDENT: To earn credit for Math I, proficiency must be shown in all sections.

A. Reduce to lowest terms:

1. \( \frac{14}{16} \)
2. \( \frac{24}{32} \)
3. \( \frac{6}{8} \)
4. \( \frac{3}{10/16} \)
5. \( \frac{16}{64} \)

Answer below:
1.
2.
3.
4.
5.

B. Convert to the required fraction:

6. \( \frac{1}{2} \) to 4ths
7. \( \frac{1}{2} \) to 10ths
8. \( \frac{3}{8} \) to 32nds
9. \( \frac{5}{8} \) to 64ths
10. \( \frac{7}{8} \) to 16ths

Answer below:
6.
7.
8.
9.
10.

C. Add and reduce to lowest terms:

11. \( \frac{1}{2} + \frac{1}{4} \)
12. \( \frac{3}{16} + \frac{1}{8} \)
13. \( 1 \frac{1}{4} + \frac{1}{4} \)
14. \( \frac{7}{8} + \frac{1}{16} \)
15. \( 10 \frac{1}{8} + \frac{1}{32} \)

Answer below:
11.
12.
13.
14.
15.
D. Multiply and reduce to lowest terms:

16. \( \frac{3}{4} \times 5 \)
17. \( \frac{2}{3} \times \frac{5}{7} \)
18. \( \frac{3}{4} \times \frac{8}{9} \)
19. \( \frac{8}{11} \times \frac{5}{12} \)
20. \( 2 \frac{1}{2} \times 3 \frac{1}{4} \)

E. Divide and reduce to lowest terms:

21. \( \frac{5/7}{3/4} \)
22. \( \frac{2/3}{5} \)
23. \( \frac{1 \frac{1}{2}}{2} \)
24. \( \frac{3}{1/2} \)
25. \( \frac{7/8}{1/4} \)

F. Give the decimal equivalent correct to 3 decimal places:

26. \( \frac{3}{4} \)
27. \( \frac{5}{16} \)
28. \( 1 \frac{5}{8} \)
29. \( \frac{1}{32} \)
30. \( \frac{1}{64} \)


31. \( 1.500 + .250 - .5 \)
32. \( .250 + 1/2 \)
33. \( 2.875 + .125 - 3.0 \)
34. \( 7/8 + .125 - 0.750 \)
35. \( 1.015 + .625 - .045 \)
H. Find the percentage:

36. 50% of 3
37. 5% of 3
38. 1% of 100
39. 6% of 500
40. 10% of 1,000
COURSE OF STUDY OUTLINE
MACHINE SHOP
APPLIED MATHEMATICS I

Specific Performances

Unit I - Numbers

Lesson 1. Meaning of Numbers

a. Defines a digit as a single number.

b. Defines a unit as a single one.

c. Defines the place value of a number in terms of its position in relation to the decimal point.

d. Places numbers in the proper numerical position.
   Groups the numbers 1-9 in the units position.

   Groups multiples of ten in the tens position.

Etc.

Assignments

a) Basic Vocational Math, Part I, page 2.

b) BVM-I, page 3.

c) BVM-I, pages 3 & 4

d) BVM-I, pages 5 & 6

e) Lesson 1 - Quiz
   BVM-I, pp. 7-13
   Handout I-1
1. A digit is the same as (choose one)
   a) a unit  
   b) a single number  
   c) a single object  
   d) any number of objects

2. Give the place value for the seven places preceding the decimal point.

   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | . | *

   Answer

3. There are_________ units in the tens place.

4. There are_________ tens in the hundreds place.

5. There are_________ hundreds in the thousands place.
COURSE OF STUDY OUTLINE
MACHINE SHOP
APPLIED MATHEMATICS I

Unit I (continued)

Lesson 2 Reading and Writing Whole Numbers

a. Refers to any number group by name such as: units, tens, twenties, hundreds, and thousands.

b. Arranges numbers in groups of three digits beginning from the decimal point and places a comma between each group.

Lesson 3 Rounding Off Numbers

a. Defines rounding off as the simplifying of a number

b. Rounds off by selecting the desired place, omits all numbers to the right of that place, substituting zeros.

If the last remaining number on the right is
1. Five or greater, adds 1
2. Four or less, leaves the same

Lesson 4 Unit Test

a) BVM-I, pages 14-16
b) BVM-I, pp. 17-19
   BVM-I, p. 20, drill #1
  c) Lesson 2, Quiz - Basic Math Skills, pp. 3 & 4
     prob. 1-10, prob. 31-38, prob. 42 and 43.

a) BVM-I, pp.23 and 24.

b) BVM-I pp. 24 (bottom)-26 (prob. 1-5 each)

  c) Lesson 3 Quiz BVM-I
     p. 27 (1-5)

a) Handout-Unit I test
Unit I - Test

Write the following numbers in numerals with commas inserted. (10 pts each)

1. Twenty-four
2. One hundred thirty-five
3. Two thousand, nine hundred and nine
4. Fourteen million, six thousand and ten
5. One hundred one thousand and one

Round off the following numbers to the third place before the decimal. (10 pts each)

6. 6,499
7. 1,501
8. 249
9. 18,652
10. 3,094
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</table>

Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed__________
Unit II - Addition of Whole Numbers and Decimals

Lesson 1. Introduction to Addition
a. Defines the numbers being added as the addend and the answer as the sum.

Lesson 2. Addition Facts
a. Demonstrates memorization of the 100 primary combinations of the digits (0,1...9).

Lesson 3. Addition of Larger Numbers
a. Aligns the decimal point in a vertical column.
b. Finds the sum of long columns.

Lesson 4. Checking Addition
a. Uses the reverse-order method to check addition.

Lesson 5. Unit Test

- a) Basic Math Skills, p. 9
- a) BMS, p 11, part 4A (This is a speed exercise; see your instructor before starting.)
- b) BMS, p 195, part A Quiz (see above instructions.)
- b) EBM, p. 16, work prob.1-13
- c) BMS, p. 137, part A, prob. 1-10
- a) EBM, p. 13
- b) BMS, pp 17-18
- c) EBM, p. 16, part B
MACHINE SHOP
APPLIED MATHEMATICS I

Unit II - Test

Find the sum; check your answers! Ten (10) points each.

1) 258.08
   42.3
   5.98
   .005
   
   2) 714.55
   1489.92
   29.76
   3.251
   .007
   
   3) 3.750
   49.25
   .812
   1.061
   
   4) .00425
   .075
   .750
   8.62
   
   5) 3.3125
   .0313
   .500
   10.000
   10.00015
   
   6) 40.16 + 108.67 + 54.047 + 80
   
   7) 2.8 + 9.04 + 16.009 + 28.1764
   
   8) .58 + 95.4 + 16.009 + 1.007
   
   9) 1.0025 + .7514 + .3095 + .2000
   
   10) 1.062 + .438 + .500 + 1.312
   
Write answers here:

1) ______________________  6) ______________________
2) ______________________  7) ______________________
3) ______________________  8) ______________________
4) ______________________  9) ______________________
5) ______________________ 10) ______________________
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Evaluation:

A B C D

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed
Unit III—Subtraction of Whole Numbers and Decimals

Lesson 1. Introduction to Subtraction
   a. Identifies the larger number as the minuend.
   b. Identifies the number to be subtracted as the subtrahend.
   c. Calls the answer the difference.

Lesson 2. Subtraction Facts
   a. Demonstrates memorization of the 100 subtraction facts.

Lesson 3. Proving Accuracy
   a. Uses the reverse-order method to check subtraction.

Lesson 4. Subtracting Decimal Fractions
   a. Aligns decimal points vertically.

Lesson 5. Unit Test
   a. Handout - Unit III Test
Unit III - Test
Subtract; check your answers. Ten (10) points each.

Problem: Write answer here:

1. 55.007 - 3.05
2. 406.810 - 53.918
3. 508.71 - 49.028
4. 612.8 - 320.806
5. 3.007 - .479
6. 87.31 - 9.025
7. 737.658 - 402.78
8. 200.4 - 89.997
9. 486.273 - 35.106
10. 271.43 - 58.7172
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</table>

Evaluation:

- Lesson 25%
- Quiz 25%
- Test 50%
- Unit Grade

Date completed: __________________
Unit IV - Multiplication of Whole Numbers and Decimals

Lesson 1. Introduction to Multiplication

a. Uses multiplication as a short method of adding equal numbers.

b. Refers to the numbers involved in the multiplication as factors.

c. Refers to the answer as the product.

Lesson 2. Multiplication Facts

a. Can demonstrate the 100 primary multiplication facts.

Lesson 3. Multiplication with One-Digit Multipliers

a. Will carry figures where necessary.

Lesson 4. Multiplication with Two- and Three-Digit Multipliers

a. Will find partial products when multiplying by two or more digits.

b. Will indent partial products in solving for the product.

Lesson 5. Multiplication with Zero in Either Factor

a. Knows that when zero is multiplied by any number the product is zero.

b. Knows that when any number is multiplied by zero, the product is zero.

\[
\begin{array}{ll}
\text{a) BMS, p. 43} & \text{b) Business & Consumer Arithmetic, pp. 24-25; read introductory statement only} \\
\text{Lesson 2. Multiplication Facts} & \\
\text{a) BMS, pp. 45-46. This is a speed exercise; see your instructor before starting.} \\
\text{Lesson 3. Multiplication with One-Digit Multipliers} & \\
\text{a) BMS, pp. 47-48} & \text{b) Lesson 3 Quiz #20; BMS, p. Q211} \\
\text{Lesson 4. Multiplication with Two- and Three-Digit Multipliers} & \\
\text{a) EBM, pp. 49-50} & \text{b) B&CM, p. 25, group 1} \\
& \text{c) B&CM, pp. 25-26, group 2 (1-15)} \\
& \text{d) Lesson 4 Quiz #21, BMS, p. Q211} \\
\text{Lesson 5. Multiplication with Zero in Either Factor} & \\
& \text{a) EBM, p. 51 (see examples C & D) Work prob. #24-50} \\
& \text{b) EBM, p. 52 (see examples C & D) Work prob. #24-50} \\
& \text{c) Lesson 5 Quiz #22, BMS, p. Q213}
\end{array}
\]
Lesson 6. Shortcuts in Multiplication

a. Can, when multiplying by 10, 100, 1000, etc. move the decimal point in the multiplicand to the right as many places as there are zeros in the multiplier.

Lesson 7. Checking Multiplication

a. Will use the reverse-order method to check multiplication.

Lesson 8. Decimals in Multiplication

a. Will give the product as many decimal places as there are decimal places in the two factors together.

Lesson 9. Unit Test

a) BMS, p. 57. Read first two paragraphs. Work prob. 1-40
b) Lesson 6, Quiz #25
BMS, p. Q215, part A

a) EBM, p. 25. See example of transposing factors
b) BMS, pp. 53-54 prob. 1-10 (use reverse-check method)

a) EBM, pp. 23-24 example 1&2

a) Handout - Unit IV Test
MACHINE SHOP
APPLIED MATHEMATICS I

Unit IV - Test

Multiply; check your answers. Five (5) points each.

1. 15 x 4   6. 78 x 14   11. 0.8 x 0.9   16. 18 x 100
2. 13 x 6   7. 86 x 11   12. 0.32 x 0.4   17. 92 x 1000
3. 11 x 8   8. 31 x 200  13. 0.25 x 0.375  18. 7.2 x 100
4. 51 x 10  9. 567 x 50  14. 3.1416 x 5   19. 0.063 x 100
5. 14 x 12  10. 52 x 4147  15. 0.813 x 4  20. 0.721 x 10

Write answers here:

1. ___________________________   11. ___________________________
2. ___________________________   12. ___________________________
3. ___________________________   13. ___________________________
4. ___________________________   14. ___________________________
5. ___________________________   15. ___________________________
6. ___________________________   16. ___________________________
7. ___________________________   17. ___________________________
8. ___________________________   18. ___________________________
9. ___________________________   19. ___________________________
10. ___________________________  20. ___________________________
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<td>Quiz - Lesson 6 Shortcuts in Multiplication</td>
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Evaluation:

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<th>B</th>
<th>C</th>
<th>D</th>
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</table>

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed
Unit V — Division of Whole Numbers and Decimals

Lesson 1. Introduction to Division

a. Uses division as a short method of subtracting as reverse of multiplication.  
   a) BMS, pp. 61-62

b. Refers to division as a process used to determine how many times one number is contained in another.

c. Can diagram a numbered line to illustrate division.

d. Refers to the number to be divided as the dividend, the divisor as the number by which the dividend is divided, the number obtained as the quotient, and the amount left over as the remainder.  
   b) EBM, p. 28

Lesson 2. Division Facts

a. Will use the 90-division facts from memory.  
   a) BMS, pp 63-64. This is a speed exercise; see your instructor before starting.

b. Will not divide by zero.  
   b) Lesson 2, Quiz 26, BMS p.Q217

Lesson 3. Dividing With One-Digit Numbers

a. Will use division as the reverse of multiplication to find the answer.  
   a) BMS. pp. 65-66

b. Will multiply the answer by the divisor to check its equality to the number being divided.  
   b) Use the multiplication method to check the above assignment.

Lesson 4. Long Division

a. Will use zero in the quotient when the divisor does not "go".  
   a) BMS, pp. 67-68, prob. 1-7

b. Lesson 4, Quiz 28, BMS p.Q219 (check your answers)
Lesson 5. Dividing with Divisors Ending in Zero

a. Will cancel the zeros in the divisor and move the decimal point an equal number in the dividend.

Lesson 6. Decimals in the Divisor

a. Will increase both the divisor and dividend proportionally.

Lesson 7. Unit Test

a) EBM, pp. 30 bottom & top 31
b) Business & Consumer Math pp. 32-33, prob. 1-15
Work 2-9 set A (skip 12 & 13).
a) Handout - Unit V Test
Name________________________________________

Date________________________________________

MACHINE SHOP
APPLIED MATHEMATICS I

Unit V - Test

Divide; check your answers. Five (5) points each.

1. \( \frac{30}{21,840} \)
2. \( \frac{40}{34,000} \)
3. \( \frac{58}{26,796} \)
4. \( \frac{57}{15,276} \)
5. \( \frac{462}{267,036} \)
6. \( \frac{4896}{72} \)
7. \( \frac{20,640}{32} \)
8. \( \frac{5292}{21} \)
9. \( \frac{169}{13} \)
10. \( \frac{26,082}{54} \)

Write answers here:

11. \( 1000 \div 10 \)
12. \( 2.75 \div 100 \)
13. \( 2.75 \div 10 \)
14. \( 3000 \div 100 \)
15. \( 32,564 \div 1000 \)
16. \( 535.65 \div 15.5 \)
17. \( 78.425 \div 6.25 \)
18. \( 97.34 \div 2.96 \)
19. \( .857 \div 125 \)
20. \( 37.625 \div 5.375 \)
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<td>Unit Test</td>
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</table>

**Evaluation:**

- Lesson 25%
- Quiz 25%
- Test 50%
- Unit Grade

Date completed ____________________
Lesson 1. Introduction to Fractions

a. Refers to the term above the fraction line as the numerator.

b. Refers to the term below the fraction line as the denominator.

c. Defines a proper fraction as one with the numerator smaller than the denominator.

d. Defines an improper fraction as one with the numerator larger than the denominator.

Lesson 2 Reducing Numbers to Improper Fractions

a. Will solve mentally for the number of fractional parts of simple whole and mixed numbers.

b. Defines a mixed number as consisting of a whole number and a fraction.

c. Converts the whole number of a mixed fraction to an equivalent improper fraction, then adds the fractional part of the mixed number.

Lesson 3. Reducing Improper Fractions to Whole or Mixed Numbers

a. Divides the numerator of the improper fraction by the denominator to obtain a whole number, leaving the remainder as a proper fraction.
Lesson 4. Reducing Fractions to Lowest Terms

a. Reduces the terms of the fraction so that each is prime to the other.

b. Reduces by dividing the numerator and denominator by a common factor.

Lesson 5. Changing a Fraction to Higher Terms

a. Multiplies both terms of the fraction by the same number to achieve the required higher denominator.

Lesson 6. Finding the Lowest Common Denominator of Two or More Fractions

a. Visually finds the lowest common denominator of shop fractions.

b. Uses the product of prime factors to find the LCD when the lowest common denominator is not visually apparent.

Lesson 7. Unit Test

a) Math for Tech. & Voc. Schools, p. 4 sec. 1-5

b) Math for Tech. & Voc. Schools, pp. 4-5 sec. 1-5, work prob. set A and 9-16 set B

c) Lesson 4 Quiz B&CA, p.44(1-20)

Lesson 5. Changing a Fraction to Higher Terms

a) Math for Tech. & Voc. Schools, p. 6, work sec. 1-6 set A

b) Lesson 5 Quiz B&CA, p.43 prob. 1-10

Lesson 6. Finding the Lowest Common Denominator of Two or More Fractions

a) Math for Tech & Voc Schools, p. 7 sec. 1-7, see example (omit last 2 para)

work set A, p. 8 prob. 1-11


Work prob. 11-24 of sets A&B

c) Lesson 6 Quiz BMS, p. 104 prob. 1-10

Lesson 7. Unit Test

a) Handout Unit VI Test
## MACHINE SHOP
### APPLIED MATHEMATICS I

Unit VI - Test  Five (5) points each

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<td>[ 3 ]</td>
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<tr>
<td>2.</td>
<td>15/4</td>
<td>[ 3 \frac{3}{8} ]</td>
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<tr>
<td>3.</td>
<td>9/8</td>
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<td>4.</td>
<td>62/32</td>
<td>[ 1 \frac{3}{8} ]</td>
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<td>5.</td>
<td>18/16</td>
<td>[ 1 \frac{1}{8} ]</td>
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<td>6.</td>
<td>1\frac{1}{2}</td>
<td>[ 2 \frac{1}{2} ]</td>
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<td>7.</td>
<td>3 1/8</td>
<td>[ 3 \frac{1}{8} ]</td>
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<td>8.</td>
<td>1 1/8</td>
<td>[ 1 \frac{1}{8} ]</td>
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<td>9.</td>
<td>1 3/16</td>
<td>[ 1 \frac{3}{16} ]</td>
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<td>6 3/4</td>
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Change to the higher terms indicated.

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<tr>
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<td>1/8 = ?/16</td>
<td>[ 16 ]</td>
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<tr>
<td>12.</td>
<td>1/8 = ?/32</td>
<td>[ 32 ]</td>
</tr>
<tr>
<td>13.</td>
<td>1/8 = ?/64</td>
<td>[ 64 ]</td>
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<tr>
<td>14.</td>
<td>3/4 = ?/32</td>
<td>[ 32 ]</td>
</tr>
<tr>
<td>15.</td>
<td>1/2 = ?/16</td>
<td>[ 16 ]</td>
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Change to improper fractions.

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<tr>
<th>Problem</th>
<th>Expression</th>
<th>Answer</th>
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</thead>
<tbody>
<tr>
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<td>[ 1/2 ]</td>
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<tr>
<td>17.</td>
<td>1/2, 2/3, 3/4</td>
<td>[ 1 ]</td>
</tr>
<tr>
<td>18.</td>
<td>5/8, 1/2, 1/16</td>
<td>[ 1/16 ]</td>
</tr>
<tr>
<td>19.</td>
<td>7/8, 5/12, 3/16</td>
<td>[ 5/12 ]</td>
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<tr>
<td>20.</td>
<td>1/100, 5/10, 3/1000</td>
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# Evaluation sheet for Unit VI

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<tr>
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<tr>
<td>1</td>
<td>Introduction to Fractions</td>
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<tr>
<td>2</td>
<td>Reducing Numbers to Improper Fractions Quiz - Lesson 2</td>
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<tr>
<td>3</td>
<td>Reducing Improper Fractions to Whole or Mixed No. Quiz Les. 3</td>
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<tr>
<td>4</td>
<td>Reducing Fractions to Lowest Terms Quiz Lesson 4</td>
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<td>5</td>
<td>Changing Fractions to Higher Terms Quiz</td>
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<td>Finding the Lowest Common Denominator of 2 or more Fractions Quiz - Lesson 6</td>
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**Evaluation:**

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<th>B</th>
<th>C</th>
<th>D</th>
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<th>Quiz 25%</th>
<th>Test 50%</th>
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<tbody>
<tr>
<td></td>
<td>Unit Grade</td>
<td>Date completed</td>
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</table>
Unit VII—Addition of Fractions

Lesson 1. Introduction

a. Will add only fractions of like denominators.

b. Will add fractions of unlike denominators only after changing to equivalent fractions.

c. Adds the numerators of the addends and writes this sum over the common denominator.

d. Reduces the resulting fraction to its lowest terms if not already so expressed.

Lesson 2 Addition of Mixed Numbers

a. Converts all mixed numbers to mixed numbers with common denominators, finds the sum and reduces to lowest terms.

Lesson 3 Unit Test

a) Math for Tech & Voc. Schools, pp. 8-9 sec 1-8, work prob. 13, 14, 15

b) Math for Tech & Voc. Schools, p. 9, study the example and work set A&B except 13,14 or 15

c) Lesson 1 Quiz BMS p. Q237 prob. 1-10

a) Math for Tech & Voc. Schools, pp. 9-10, work sec. 1-9, set A&B prob. 29-32

b) Math for Tech & Voc. Schools, pp. 22-23, work prob. 1-6

c) Lesson 2 Quiz Math for T&V Schools, pp. 24-25, work prob. 7-11

a) Handout - Unit VII Test
MACHINE SHOP
APPLIED MATHEMATICS I

Unit VII - Test

Add, reduce to lowest terms. Seven (7) points each

<p>| | | | | |</p>
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<tr>
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</thead>
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<tr>
<td>1.</td>
<td>$\frac{1}{8} + \frac{3}{8} + \frac{5}{8}$</td>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>$\frac{1}{16} + \frac{3}{16} + \frac{15}{16} + \frac{7}{16}$</td>
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<td></td>
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<tr>
<td>3.</td>
<td>$\frac{5}{32} + \frac{1}{32} + \frac{29}{32}$</td>
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<td>4.</td>
<td>$\frac{1}{4} + \frac{2}{4} + \frac{3}{4}$</td>
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<tr>
<td>6.</td>
<td>$3 \frac{1}{8} + \frac{3}{8}$</td>
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<tr>
<td>7.</td>
<td>$7 \frac{1}{16} + 1 \frac{3}{32} + 3 \frac{1}{4} + 1$</td>
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<tr>
<td>8.</td>
<td>$5 \frac{1}{16} + \frac{1}{3} + \frac{3}{64}$</td>
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<tr>
<td>9.</td>
<td>$3 \frac{5}{8} + 1 \frac{1}{16} + 2 \frac{1}{32}$</td>
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<td>$15 \frac{1}{2} + 12 \frac{15}{16} + \frac{1}{4}$</td>
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<td>11.</td>
<td>$3 \frac{1}{32} + 1 \frac{1}{2} + 2 \frac{3}{4}$</td>
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<tr>
<td>12.</td>
<td>$2 \frac{1}{5} + 8 \frac{2}{3} + 10 \frac{3}{4} + 4 \frac{3}{7}$</td>
<td>12.</td>
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<tr>
<td>13.</td>
<td>$6 \frac{7}{16} + \frac{7}{8} + 2 \frac{3}{3}$</td>
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<tr>
<td>14.</td>
<td>$6 \frac{7}{16} + \frac{7}{8} + 2 \frac{3}{3} + 3 \frac{3}{4}$</td>
<td>14.</td>
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<tr>
<td>15.</td>
<td>$4 + 11 \frac{3}{5} + \frac{7}{8} + 3 \frac{1}{2}$</td>
<td>15.</td>
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Write answers here:

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<tr>
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# Applied Mathematics I

## Evaluation sheet for Unit VII

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<tr>
<td></td>
<td>Quiz Lesson 2</td>
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<tr>
<td>2</td>
<td>Addition of Mixed Numbers</td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>Unit Test</td>
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### Evaluation:

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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</table>

**Evaluation:**

- Lesson 25%
- Quiz 25%
- Test 50%
- Unit Grade

Date completed: _______________
Unit VIII—Subtraction of Fractions

Lesson 1. Introduction

  a. Subtracts only fractions with like denominators.

  b. Converts all fractions with unlike denominators to equivalent fractions before subtracting.

  c. Reduces the result to lowest terms when not already so expressed.

  a) Math for Tech & Voc. Schools, pp. 10-11, example 1, work prob. 1-2 set A

  b) Math for Tech & Voc. Schools, p. 11, example 2, work prob. 3-12 set A

  c) Lesson 1 Quiz Math for T & V Schools, p. 11, work prob. 13-20

Lesson 2. Subtraction of Mixed Numbers

  a. Converts the fractional parts to equivalent fractions with a common denominator if not already so expressed.

  b. When necessary, borrows one from the whole number of the minuend, then adds the denominator to the numerator of the minuend.

  c. Finds the difference and reduces to lowest terms

  a) Math for T & V Schools, p. 12, study example 1. Work prob. 1-5 set A

  b) Math for T & V Schools, p. 12, see example 2

  c) Math for T & V Schools, pp. 12-13, work prob. 6-12 set A. Pp. 26-29, prob. 12, 13, 28, 29

  d) Lesson 2 Quiz, work prob. 15, 16, 21, 22, 23, 24, set B

Lesson 3. Unit Test

  a) Handout Unit VIII Test
Unit VIII - Test

Find the difference. Reduce to lowest terms. Five (5) points each.

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<td>( \frac{1}{2} - \frac{1}{5} )</td>
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<td>( \frac{1}{2} - \frac{1}{4} )</td>
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<td>4</td>
<td>( \frac{3}{4} - \frac{3}{8} )</td>
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<td>( \frac{3}{5} - \frac{1}{2} )</td>
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<tr>
<td>6</td>
<td>( \frac{2}{3} - \frac{1}{2} )</td>
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<td>7</td>
<td>( \frac{5}{6} - \frac{2}{3} )</td>
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<td>8</td>
<td>( \frac{4}{5} - \frac{1}{3} )</td>
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<tr>
<td>9</td>
<td>( \frac{8}{9} - \frac{2}{3} )</td>
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<td>( \frac{15}{16} - \frac{15}{32} )</td>
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<td>( 4 \frac{5}{16} - 1 \frac{1}{16} )</td>
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<td>14</td>
<td>( \frac{63}{64} - \frac{1}{32} )</td>
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<tr>
<td>15</td>
<td>( 1 \frac{7}{8} - \frac{3}{32} )</td>
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<tr>
<td>16</td>
<td>( 12 - 6 \frac{1}{32} )</td>
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<td>17</td>
<td>( 18 \frac{5}{32} - 5 \frac{3}{64} )</td>
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<td>18</td>
<td>( 1 - \frac{63}{64} )</td>
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<td>( 1\frac{1}{2} - 13/16 )</td>
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<td>Title</td>
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<td>Quiz Lesson 2</td>
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<td>Subtraction of Mixed Numbers</td>
</tr>
<tr>
<td>3</td>
<td>Unit Test</td>
</tr>
</tbody>
</table>

**Evaluation:**

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

*Date completed________________*
Unit IX — Multiplying Fractions

Lesson 1. Multiplying Common Fractions

a. Finds the product of two or more fractions by placing the product of the numerators over the product of the denominator.

b. Reduces the terms of the fractions, whenever possible, before finding the product by dividing any pairs of terms by the same number.

Lesson 2. Multiplication of Mixed Numbers

a. Changes mixed numbers to improper fractions, and proceeds as with common fractions.

Lesson 3. Word Problems in Multiplying Fractions

a. Substitutes the multiplication sign (x) for the word "of" in word problems.

Lesson 4. Unit Test

a) Math for T & V Schools
   pp. 13-15, examples 1-4

b) Math for T & V Schools,
   pp. 14-15, examples 3 & 4;
   work prob. 1-8 set A
   and 13-16 set B, p. 16

b) Math for T & V Schools,
   p. 15, see example 5;
   work prob. 9-12 set A and
   19-23 set B, p. 16

b) Math for T & V Schools,
   Lesson 2 Quiz prob. 20, p.27

a) Math for T & V Schools,
   pp. 15-16, example 6 & 7,
   work prob. 25-29, set C

a) Handout Unit IX Test
Find the product; reduce to lowest terms. Five (5) points each.

Write answers here:

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</tr>
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<td>3/4 x 2</td>
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<td>3.</td>
<td>1/2 x 1/2</td>
</tr>
<tr>
<td>4.</td>
<td>3/8 x 5/8</td>
</tr>
<tr>
<td>5.</td>
<td>31/32 x 3/31</td>
</tr>
<tr>
<td>6.</td>
<td>5/64 x 2</td>
</tr>
<tr>
<td>7.</td>
<td>4 x 7/64</td>
</tr>
<tr>
<td>8.</td>
<td>1 1/2 x 2</td>
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<tr>
<td>9.</td>
<td>4 5/8 x 3/4</td>
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<tr>
<td>10.</td>
<td>2 1/16 x 3 1/8</td>
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<td>11.</td>
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<td>1/8 of 1</td>
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<td>5/8 of 8</td>
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<td>16.</td>
<td>15/16 of 2</td>
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<td>17.</td>
<td>1/2 of 3/4 x 2</td>
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<td>18.</td>
<td>1/2 of 1/2</td>
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<tr>
<td>19.</td>
<td>1 2/5 x 3 1/2 x 2</td>
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<tr>
<td>20.</td>
<td>12 3/8 x 1/2 x 3 1/2</td>
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<tr>
<td>Lesson #</td>
<td>Title</td>
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<td>Word Problems in Mult. Fraction</td>
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</table>

Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed
Unit X - Division of Fractions

Lesson 1. Introduction

a. Uses division to find how many times one number is contained in another.

b. Changes the division problem to a multiplication problem to find the product.

c. Refers to the above process as "inverting".

Lesson 2. Division of Mixed Numbers

a. Converts mixed numbers to improper fractions, sets the problem up as a multiplication problem and proceeds to find the product.

Lesson 3. Division of Complex Fractions

a. Understands that a complex fraction is one in which the numerator or denominator or both are fractions or mixed numbers.

b. Changes a complex fraction to a multiplication problem, then finds the product.

c. Changes mixed numbers in complex fractions to improper fractions then proceeds as above.

Lesson 4. Unit Test

a) Math for T & V Schools, pp. 16-17, example 1 incl. the explanation. Examples 2 & 4; work prob. 1-7, 10 & 11 set A

Lesson 2 Quiz 53 BMS, p. Q248, part B, prob. 1-10

Lesson 3 Quiz BMS p.Q247 quiz 54

Lesson 4. Unit Test

a) Handout Unit X Test
MACHINE SHOP
APPLIED MATHEMATICS I

Unit X - Test

Divide; reduce to lowest terms. Five (5) points each.

Write answers here:

1. \(4 \div \frac{2}{3}\)
2. \(9 \div \frac{3}{4}\)
3. \(15 \div \frac{3}{5}\)
4. \(20 \div \frac{5}{6}\)
5. \(2 \div \frac{5}{8}\)
6. \(\frac{3}{4} \div 4\)
7. \(\frac{6}{11} \div 7\)
8. \(\frac{1}{3} \div \frac{2}{3}\)
9. \(\frac{\frac{1}{8}}{\frac{3}{4}}\)
10. \(\frac{5}{8} \div \frac{2}{3}\)
11. \(\frac{4}{3} \div \frac{2}{18}\)
12. \(\frac{15}{16} \div \frac{1}{16}\)
13. \(\frac{4}{21} \div \frac{8}{16}\)
14. \(\frac{7}{16} \div \frac{2}{3}\)
15. \(\frac{1\frac{7}{16}}{\frac{4}{3}}\)
16. \(\frac{12\frac{2}{8}}{\frac{6}{316}}\)
17. \(\frac{5\frac{1}{2}}{\frac{2}{3}}\)
18. \(\frac{12\frac{5}{32}}{\frac{3}{8}}\)
19. \(\frac{8}{1\frac{5}{8}}\)
20. \(\frac{1\frac{5}{8}}{8}\)

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Evaluation sheet for Unit X  Division of Fractions

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<td>Division of Complex Fractions</td>
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Lesson 25%  
Quiz 25%  
Test 50%  
Unit Grade

Date completed

40 45
Unit XI - Fraction Problems Involving Combined Operations

Lesson 1. Problems involving only multiplication & division

a. If the problem contains division, knows that the dividing fraction shall be converted to an improper fraction, inverted, and the problem solved as ordinary multiplication.

a) Math for T & V Schools, pp. 18-19, study the example given; work prob. 1-8, set A

b) Lesson 1 Quiz Math T&V Schools, p 19, prob. 13-22 set B

Lesson 2. Problems involving addition and subtraction

a. Simplifies either or both the numerator and denominator by performing the indicated addition or subtraction first, then solving the remaining complex fraction.

a) Math for T & V Schools, pp. 19-20, see example 3; work prob. 6, 7, 8, set A and 13, 14, 15, 20, 21, 22 set B

Lesson 3. Unit Test

a) Handout Unit XI Test
MACHINE SHOP
APPLIED MATHEMATICS I

Unit XI - Test

Perform the indicated operations; reduce to lowest terms.
Ten (10) points each.

1. \( \frac{3\frac{1}{2} \times 4\frac{1}{2}}{5 \times 2\frac{1}{2}} \)
2. \( \frac{\frac{1}{2} \div 1/8}{\frac{1}{2} \times \frac{1}{2}} \)
3. \( \frac{\frac{5}{8} \times \frac{3}{8}}{\frac{3}{4} - 1/8} \)
4. \( \frac{7/8 - \frac{1}{8}}{3/4 \div 3/8} \)
5. \( \frac{7/8 \times \frac{1}{8}}{3/4 \div 3/8} \)

6. \( \frac{4 9/16 - 3 1/8}{2\frac{1}{2} + 1 3/16} \)
7. \( \frac{3 9/16 + 5\frac{1}{4}}{4\frac{1}{4} - 2\frac{1}{2}} \)
8. \( \frac{1 7/8 \times 3/4}{1 5/32 + 1 5/16} \)
9. \( \frac{2 1/8 + 3 1/32}{4 1/8 \div 4} \)
10. \( \frac{15/16 \times \frac{1}{8}}{2} \)

Write answers here:

1. __________________________  
2. __________________________  
3. __________________________  
4. __________________________  
5. __________________________  
6. __________________________  
7. __________________________  
8. __________________________  
9. __________________________  
10. __________________________
### Applied Mathematics I

**Evaluation sheet for Unit XI**

**Fraction Problems Involving Comb. Operations**

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<tr>
<td>2</td>
<td>Problems Involving Addition and Subtraction</td>
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</table>

**Evaluation:**

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed ________________________
Unit XII - Decimal Fractions

Lesson 1. Introduction

a. Defines a decimal fraction as any number to the right of the decimal point. 

b. Refers to any number group by name such as: 
   .1 (one tenth),
   .01 (one hundredth) etc.

Lesson 2. Reducing a Decimal Fraction to a Common Fraction

a. Places the number over the denominator containing 1 and as many zeros as there are decimal places to the right of the decimal.

b. Reduces the common fraction to lowest terms.

Lesson 3. Changing a Fraction to a Decimal

a. Divides the numerator by the denominator, carrying out to four places, and rounds off to three places.

Lesson 4. Table of Decimal Equivalents

a. Will use shop-wall or pocket tables of decimal equivalents to convert common shop fractions such as 64ths, etc. to decimal fractions.

Lesson 5 Unit Test

a) Math for T & V Schools, p. 30

b) See "a" above; write prob. 1-8 set A and 9-16 set B

a) Math for T & V Schools, pp. 31-32, example 1-3; work prob. 1-15 set A and 17-24 set B

a) Math for T & V Schools, p. 33, example 1; work prob. 1-20 set A, pp. 34-35

a) Math for T & V Schools, give answers to nearest 64th and in three decimal places, p 47: work prob. 5,8,16,24,25,26,27,28, & 33.

a) Handout Unit XII Test
Unit XII - Test

Using your decimal-equivalent tables, locate and give the appropriate decimal or fractional equivalent for each.

Time - Five (5) minutes; four (4) points each.

Write answers here:

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<td>1.</td>
<td>½</td>
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<td>14.</td>
<td>.875</td>
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<td>2.</td>
<td>15/16</td>
<td></td>
<td>15.</td>
<td>.685</td>
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<tr>
<td>3.</td>
<td>1/16</td>
<td></td>
<td>16.</td>
<td>.689</td>
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<tr>
<td>4.</td>
<td>1/8</td>
<td></td>
<td>17.</td>
<td>.438</td>
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<tr>
<td>5.</td>
<td>7/8</td>
<td></td>
<td>18.</td>
<td>.031</td>
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<tr>
<td>6.</td>
<td>1/32</td>
<td></td>
<td>19.</td>
<td>.063</td>
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<td>7.</td>
<td>13/16</td>
<td></td>
<td>20.</td>
<td>.656</td>
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<td>8.</td>
<td>3/4</td>
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<td>21.</td>
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<td>9.</td>
<td>¾</td>
<td></td>
<td>22.</td>
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<td>10.</td>
<td>5/16</td>
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<td>23.</td>
<td>.558</td>
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<td>11.</td>
<td>3/8</td>
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<td>24.</td>
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<td>12.</td>
<td>15/32</td>
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<td>25.</td>
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<td>Changing a Fraction to a Decimal</td>
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Evaluation:

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Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed__________________
Unit XIII - Percentage

Lesson 1. Definitions

a. Will define percent in terms of hundredths of a unit.

b. Will define the symbol (%) as a way of writing hundredths in a percentage problem.

c. Explains percentage as the product of base and rate.

Lesson 2. Percent Equivalents

a. Changes percent to a decimal fraction by removing the percent sign and moving the decimal two places to the left.

Lesson 3. Finding Percentage

a. Converts the percent to a decimal fraction (the rate of percent) and multiplies this times the base.

b. Solves everyday percentage problems involving wages, taxes and payroll deductions.

Lesson 4, Unit Test

a) Math for T & V Schools, p. 53, section 3-1

a) BMS, p. 159 example A; work prob. 1-15, part A

a) Math for T & V Schools, pp. 53-55; work the even-numbered prob. 2-40, set A and 41,45,47, and 50 set B

b) EBM, pp. 211-212, see example 1-2; work prob. 1-4 p. 223. Math for T & V Schools, pp. 54-55, work prob. 42,43, 44,51, 52 Set B

a) Handout Unit XIII Test

47
Unit XIII - Test

Find the percentage. Ten (10) points each. Write the answers below:

1. 10% of 50
2. 10% of 500
3. 1% of 500
4. 100% of 25
5. 3.5% of 100
6. 6% of $10,000
7. 12.5% of $2,500
8. A man earns $4 per hour, works 40 hours, and has deductions from his pay of
   (a) 5.85% for Social Security,
   (b) 15% for income tax.
   What is his take-home pay? (Figure both taxes on his whole earnings.)
9. The sticker price of a $4,200 car is discounted 15% by the salesman. What is the selling price?
10. A man earns $4.02 per hour and receives a 5% raise.
    (a) What is his new hourly rate?
    (b) How much more per 40-hour week can he expect?
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<td>Percent Equivalents</td>
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Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed ____________

Unit Grade 49

A B C D
Introduction

MACHINE SHOP

APPLIED MATHEMATICS II

The specific performances listed in this outline are basic requirements for the machinist who makes his own set-ups and mathematical calculations involving angles, tapers, gear and pulley ratios, and indexing. The math skills mastered in these units open the door to the worker who plans to progress beyond the levels of the semi-skilled machine operator.

The outline is constructed for individual instruction. Only those students who have completed the requirements for Machine Shop I Mathematics may enroll. The individual who feels he has the necessary math background to earn credit for units contained in this outline may begin by taking and completing tests until he reaches his highest level of performance. An individual's instruction will start at that point and continue until he has mastered the performances outlined in Applied Mathematics II for Machine Shop.

Satisfactory completion of Part II provides the math skills needed to meet the performance requirements of the second class machinist classification. Only those students who meet both shop and Math II requirements will be recommended for employment as a second class machinist.
LIST OF TEXT AND REFERENCE BOOKS

MACHINE SHOP

APPLIED MATHEMATICS II


Mathematics for Vocational and Technical Schools, Slade, Margolis and Boyce, John Wiley and Sons, Inc.

Unit I - Ratio & Proportion

Lesson 1. Ratio

a. Writes a ratio as a comparison of two like quantities.
b. Writes a ratio as a fraction reduced to lowest terms.
c. Obtains an inverse ratio by inverting the terms of the ratio.

d) Lesson 1 Quiz B&CA p. 107 prob. 1-8; give the inverse of the above problems; work prob. 1-4 p. 108

Lesson 2. Proportion

a. Writes one ratio equal to another to form a proportion.
b. Selects the outside terms of a proportion as the extremes and the inside terms as the means.
c. Finds an unknown term by setting the product of the means equal to the product of the extremes.
d. Solves for unknowns involving inverse proportion such as pulleys and gears as in "c" above after inverting the terms of the appropriate ratio.

d) Math for T & V Schools, p. 66, work prob. 6,7,8. B&CA p. 109, work prob. 1-5 p. 111

e) Lesson 2 Quiz B&CA p. 109 prob. 1,2,4,5. Math for T & V School, pp. 351-352 prob. 1-5 set A

Lesson 3, Unit Test

a) Handout Unit I Test
Name___________________________
Date____________________________

MACHINE SHOP MATHEMATICS II

Unit I - Test

Write the ratio of the numbers below as a fraction. Reduce to lowest terms.
(25 points)

1. 15 : 3
2. 40 to 1
3. 1.5 to 3
4. 5 1/4 to 20
5. 1 : 1

Give the inverse ratio of each pair of numbers below. Reduce to lowest terms.
(25 points)

6. 12 to 3
7. 4 to 9
8. 13 : 169
9. 1 : 2
10. 5.5 : 11

11. A machinist produces 5 pieces of work in 8 hours. How long must he work
to produce 41 pieces? (10 points)

12. A coolant mixture for grinding work calls for a ratio of 40 parts water to
one part soluble oil. How much oil is to be added to fifteen gallons of
water? (10 points)

13. A drill feeds in a workpiece .010 inches per revolution. How far will the
tool advance in one minute if it revolves at 300 revolutions per minute?
(10 points)

14. A machinist earns $48 in 8 hours at straight rate. What are his earnings for
Saturday work at time and one-half rate? (10 points)

15. A 3-inch-diameter pulley drives a 20-inch pulley. If the driving pulley
rotates at 1750 RPM, then what RPM is the driven pulley operating at?
(10 points)

16. What RPM can be expected of a 4-inch-diameter pulley if the 8½-inch-diameter
driving pulley rotates at 200 RPM? (Bonus - 10 points)

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Evaluation:

Lesson 25%  
Quiz 25%  
Test 50%  
Unit Grade

Date completed ___________________
Unit II - Squares, Square Root & Their Application

Lesson 1. Finding the square of a number.

a. Uses exponents to indicate a number is being squared.
   a) Math for T & V Schools, pp. 78-79 section 5-5

b. Finds the square of a number by multiplying it by itself.
   b) Math for T & V Schools, pp. 79-80, work prob. 1,2,4,8,9, set A

c. Uses tables of squares to find the squares of whole numbers.
   c) Find and list the squares of the numbers from 25 to 500 by 25s;
      example 25²=625
      50²=2500 etc.

Lesson 2. Finding the square root of whole numbers

a. Uses the square root sign to indicate square root is to be found.
   a) Math for T & V Schools, pp. 79-80

b. Finds the square root of common exact squares visually.
   b) Math for T & V Schools, p. 80; prob. 3,5,6,7, 10,11,12

c. Uses trial divisors in solving for square root when the answers are not visually apparent.
   c) Math for T & V Schools, pp. 80-81

d. Uses square-root tables to find the square root of perfect squares and as a check for problems worked out.
   d) Math for T & V Schools; work prob. 1-11, set A, p. 83 using tables at the end of the book

Lesson 3. Finding the square root of a fraction or mixed number

a. Converts fractional parts of mixed numbers to a decimal number.
   a) Math for T & V Schools, p. 81, set up but don't work prob. 30,31,32,36 p. 84 set C

b. Divides the number into pairs to the right and left of the decimal point. Adds pairs of zeros as necessary to obtain the desired number of places after the decimal.
   b) Math for T & V Schools, pp. 81-82 work prob. 30,31,32,36 p. 84 set C. Work prob. 13-18 p. 84 set B

c. Lesson 3 Quiz Math for T&V Schools, p. 83, work prob. 6,8,9,10 set B section 5-7
Lesson 4. Application of square root

a. Can prove the Pythagorean Theorem in the solution of right triangles.

b. Finds the hypotenuse of a right triangle when given both sides by applying the formula:

\[ c = \sqrt{a^2 + b^2} \]

c. Finds the altitude of a right triangle when given the base and hypotenuse by applying the formula:

\[ a = \sqrt{c^2 - b^2} \]

d. Finds the base of a right triangle when given the altitude and hypotenuse by applying the formula:

\[ b = \sqrt{c^2 - a^2} \]

Lesson 5. Practical problems involving the solution of triangles

a. Uses the Pythagorean Theorem to find missing dimensions in the machining and inspection of a workpiece.

Lesson 6. Unit Test

a) Math for T & V Schools, pp. 85-86
b) Math for T & V Schools, p. 86 see example 1. Work prob. 1-14, set A pp. 88-89
c) Math for T & V Schools, p. 87, see example 2; work prob. 5-8 set A, p. 89
d) Math for T & V Schools, p. 88, see example 3. Work prob. 9-12 set A, p. 89

a) Math for T & V Schools, pp. 89-91, work prob. 13, 14, 16, 19 p. 91
b) Lesson 5 Quiz work prob. 22 & 29, pp. 112-114

a) Handout - Unit XV Test
MACHINE SHOP
APPLIED MATHEMATICS II

Unit II - Test

Give the square of each number below. Five (5) points each.

Write answers here:
1. 9
2. 15
3. 3.50
4. 6.312
5. 10 3/4

Find the square root to an accuracy of three decimal places. Five (5) points each.

Write answers here:
6. \( \sqrt{169} \)
7. \( \sqrt{225} \)
8. \( \sqrt{7.625} \)
9. \( \sqrt{11.250} \)
10. \( \sqrt{.875} \)

Solve the following practical problems. Find the missing sides indicated by the letter X, Y, or Z. Ten (10) points each.

11.

12.

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<td>Finding the Square of a Number</td>
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<td>2</td>
<td>Finding the Square Root of Whole Numbers</td>
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<td>Finding the Square Root of a Fraction or Mix.No. Quiz Les. 3</td>
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<td>Application of Square Root Quiz Lesson 4</td>
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<td>Practical Problems Involving the Solution of Triangles Quiz Les. 5</td>
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<th>Unit Grade</th>
<th>Date completed</th>
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**Evaluation Sheet for Unit II**

**Squares, Square Root & Their Application**

Date completed: ___________________
Unit III—Regular Polygons

Lesson 1. Introduction

a. Uses the work "polygon" to describe any closed plane figure having three or more sides.

b. Understands that tables of constants are readily available in shop handbooks to shorten everyday computations involving plane figures.

Lesson 2. Three-Sided Polygons (Triangles)

a. Defines a triangle having three equal sides as being equilateral.

b. Uses formulas from the table of constants to solve problems involving equilateral triangles.

Finds altitude knowing the length of one side.
Finds area knowing one side.
Finds side knowing altitude.

Lesson 3. Four-Sided Polygons (Squares)

a. Defines a square as having four equal sides and 90-degree corner angles.

b. Uses formulas from the table of constants to solve problems involving squares.

Finds diagonal knowing one side.
Finds area knowing one side.
Lesson 4. Six-Sided Polygons (Regular Hexagons)

a. Defines a regular hexagon as having equal sides and angles.

b. Uses formulas from the table of constants to solve problems involving regular hexagons. Finds diagonal knowing distance across flats.

Lesson 5. Practical Applications of the Table of Constants

a. Uses the formulas listed in the table of constants to solve everyday shop problems.

Lesson 6. Unit Test

a) Handout Unit XVI Test (Practical Shop Problems)
MACHINE SHOP
APPLIED MATHEMATICS II

Unit III - Test

Use the table of constants to solve the following common shop problems. Twenty (20) points each.

1. Find the flat of a \( \frac{1}{4} \) inch x 45-degree chamfer.

2. What size square can be milled on the end of 1 1/8-inch round stock?

3. What diameter round stock is needed to mill a 1-inch hex on its end?

4. A triangular punch has equal sides 1.500 inches each. What is the measurement from base to top? Answer in three-place accuracy.

5. What is the area the above punch will remove in one stroke from a flat sheet during punching operations?

Write answers here:

1.

2.

3.

4.

5.
<table>
<thead>
<tr>
<th>Lesson #</th>
<th>Title</th>
<th>Level</th>
<th>Comment</th>
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<tr>
<td>1</td>
<td>Introduction</td>
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<tr>
<td>2</td>
<td>Three Sided Polygons</td>
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<td>3</td>
<td>Four Sided Polygons</td>
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<tr>
<td>4</td>
<td>Six Sided Polygons</td>
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<tr>
<td>5</td>
<td>Practical Applications of the Table of Constants</td>
<td></td>
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<tr>
<td>6</td>
<td>Unit Test</td>
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Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed
Unit IV - Circles

Lesson 1. Introduction

a. Defines circumference as the distance around a circle.

b. Defines radius as the distance from the center to the circumference.

c. Defines the diameter as a line across the circle thru the exact center.

Lesson 2. Circumference

a. Defines \( \pi \) as a symbol representing a ratio of circle circumference to diameter.

b. Finds circumference knowing diameter using the formula:

\[ c = \pi D \]

\( \pi = 3.1416 \) for machine-shop accuracy.

Lesson 3. Area

a. Multiplies \( \pi \) by the radius squared.

\[ a = \pi \cdot r^2 \]

\[ a = 3.1416 \cdot r^2 \]

Lesson 4. Areas of Ring Sections

a. Subtracts the area of the inner circle from the outside circle.

Lesson 5. Unit Test

a) Math for T & V Schools, p. 126, section 6-14
a) Math for T & V Schools, pp. 126-127, section 6-15
b) Math for T & V Schools, p. 127, work prob. 3-7, 9, 10, 12, 13, 17 set A. Give answers in three decimal places.
a) Math for T & V Schools, p. 129, section 6-17, work prob. 4, 5, 6, 11, 13, 14, 15
a) Math for T & V Schools, pp. 136-137, work prob. 1, 2, 4, 6, 9
a) Handout Unit XVII Test Practical Shop Problems
Unit IV - Test

Twenty (20) points each.

1. A large steel casting is being turned on a vertical boring mill to
98.600 + .000
- .020 inches diameter.
How many feet of steel must the bit pass through each revolution?
Answer

2. If the above casting weighs 90 pounds per foot of surface area on its end, what is the total weight?
Answer

3. If a 30-inch diameter section is to be bored through a 48-inch diameter steel plate weighing 2.5 pounds per square inch, what will the remaining ring weigh?
Answer

4. A sheet of metal must be machined so that when it is rolled it will form a tube exactly 24 inches in diameter. What is the exact width needed before rolling?
Answer

5. Five bolt holes are being equally spaced on a 3.250 radius; what is the diameter of the bolt circle?
Answer
### Evaluation sheet for Unit IV  
#### Circles

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<td>2</td>
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<tr>
<td>3</td>
<td>Area</td>
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<td>4</td>
<td>Area of Ring Sections</td>
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<td>Unit Test</td>
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**Evaluation:**

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<th>B</th>
<th>C</th>
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Lesson 25%  
Quiz 25%  
Test 50%  
Unit Grade  

Date completed

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Specific Performances

Unit V - Arcs and Circles

Lesson 1. Definitions

a. Defines a sector as a pie-shaped section of a circle.

b. Defines an arc as part of a circumference.

c. Defines the angle formed by a sector as the central angle.

Lesson 2. Finding the Length of an Arc

a. Multiplies the circle's circumference by the ratio of the central angle to 360 degrees.

Length = C \times \frac{\text{Central Angle}}{360^\circ}

Lesson 3. Finding the Area of a Sector

a. Multiplies the area of the circle by the ratio of the central angle to 360 degrees.

Sector = A \times \frac{\text{Central Angle}}{360^\circ}

Lesson 4 - Unit Test

Assignments

a. Math for V & T Schools, p. 139, section 6-24

Assignments

a. Math for V & T Schools, p. 139, see example 1. Work part (a) of Set A, p. 140, problems 1-10.

Assignments

a. Math for V & T Schools, pp. 139-140, see example 2. Work part (b) of Set A, p. 140, problems 1-10.

Assignments

Handout Unit Test
MACHINE SHOP MATHEMATICS II

Unit V - Test

Find the circumference to three decimal places. Five (5) points each.

1. 10" diameter
2. .625" diameter
3. 1.562" diameter
4. 6'3" diameter
5. 1" diameter

Write answers here:

Find the length of arc to three decimal places. Five (5) points each.

6. 6" radius, 45° central angle
7. 1/2" radius, 30° central angle
8. 2.500 radius, 15° 30' central angle
9. 1/4" radius, 135° central angle
10. .625 radius, 270° central angle

Twenty-five (25) points.

11. Find the length of a piece of sheet metal that must fit exactly around a 6-inch square that has 1-inch radius corners.

Five (5) points each.

12.-16. Find the area of the sectors in problems #6-10 to two decimal places.

12.________________________
13.________________________
14.________________________
15.________________________
16.________________________

Write answers here:
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<tr>
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<td>Definitions</td>
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<tr>
<td>2</td>
<td>Finding the Length of an Arc</td>
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<td>3</td>
<td>Finding the Area of a Sector</td>
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<td>4</td>
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Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed
Specific Performances

Unit VI - Fundamentals of Trigonometry

Lesson 1. Introduction to Right Triangles

a. Can locate and identify the parts of the right triangle.

b. Can prove that in similar triangles, the ratio of sides to each other remains the same.

Assignments

a. Basic Mathematics Simplified, p. 380 part A.

b. Essential Mathematics, p. 514, problems 1-10

c. B.M.S., p. 382, work part A.

d. Quiz - Lesson 1
A. Draw a right triangle below measuring 3 x 4 x 5 inches. Make scale full size.
Label: Angles A, B, C
sides a & b
side opposite angle A
side adjacent to angle A
the hypotenuse "c"

B. Which angle is a right angle? (Circle the answer).
1. Angle A 2. Angle B 3. Angle C

C. Use the Pythagorean Theorem to prove the 3-4-5 triangle is a right triangle.
\( c^2 = a^2 + b^2 \)

D. At the midpoint of line AC, draw a line perpendicular to AC and intersecting line AB.
1. What is the ratio of the original opposite and adjacent sides of angle A to each other?
2. What is the ratio of the new opposite and adjacent sides of angle A (in the smaller triangle formed)?
   Does the ratio of part 1 differ from part 2? Yes. No.
   Why?
Specific Performances

Unit VI - (Continued)

Lesson 2. Trig. Functions

a. Can write the six terms used to express the ratios between sides.

b. Finds the tangent ratio by dividing the opposite side by the adjacent side.
   i.e. \[ \tan A = \frac{\text{Opp}}{\text{Adj}} \]

c. Visualizes and draws a right triangle to find the tangent ratio when the acute angle is given.

d. Finds the cosine ratio by dividing the side adjacent by the hypotenuse.
   i.e. \[ \cos A = \frac{\text{Adj}}{\text{Hyp}} \]

e. Finds the sine ratio by dividing the side opposite by the hypotenuse.
   i.e. \[ \sin A = \frac{\text{Opp}}{\text{Hyp}} \]

Assignments

a. B.M.S., pp. 380-381, part B. On the back side of a 3x5 card, draw a right triangle and label all its sides and angles by letters.


e. E.M., p. 525, work problems 1, 14 and 15.
1. Draw a right triangle below and label the angles, sides a, b, c, opposite side of angle A, adjacent side of angle A, and the hypotenuse. (50 points)

2. Fill in the missing information. The ratios are to be given for angle A. (50 points)

<table>
<thead>
<tr>
<th>Side a</th>
<th>Side b</th>
<th>Hypotenuse</th>
<th>Tangent Ratio</th>
<th>Cosine Ratio</th>
<th>Sine Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4.</td>
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<tr>
<td>12</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>8.000</td>
<td>6.000</td>
<td>10.000</td>
<td></td>
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<tr>
<td>3.500</td>
<td></td>
<td>7.000</td>
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<td></td>
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<tr>
<td></td>
<td>1.000</td>
<td>1.414</td>
<td></td>
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</tr>
</tbody>
</table>
Evaluation sheet for: Unit VI - Fundamentals of Trigonometry

<table>
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<tr>
<th>Lesson #</th>
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<th>Comment</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to Right Triangles</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Quiz - Lesson 1</td>
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<tr>
<td>2</td>
<td>Trig. Functions</td>
<td></td>
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<tr>
<td>3</td>
<td>Unit Test</td>
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</tbody>
</table>

Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed: ____________________
Specific Performances

Unit VII - Use of Trigonometric Tables

Lesson 1. Finding the ratio corresponding to a given angle.

a. For angles less than 45 degrees, reads down the trig. table.
   For angles 45 degrees to 90 degrees, reads up the trig. table.

Assignments

   Work set A prob. 1-20
   Work set B, prob. 20-40
   Use the trig. tables in the Machinery's Handbook.

Lesson 2. Finding an angle corresponding to a given function.

a. Locates the ratio given under the appropriate function, and finds the corresponding angle.

Assignments

   Work prob. 1-40. Use the Machinery's Handbook Tables.
Give the trigonometric ratio for the following angles.

1. Sin 30° ___________  
2. Cos 45° ___________  
3. Tan 60° ___________  
4. Tan 15° ___________  
5. Cos 75° ___________  
6. Cos 3°16' _________  
7. Sin 15°32' _________  
8. Tan 54°12' _________  
9. Cos 89°48' _________  
10. Sin 44°13' _________  

Give the angle for the following trigonometric ratios.

11. sin = .03926 Angle ______________  
12. sin = .75756 " ______________  
13. tan = .28674 " ______________  
14. cos = .29237 " ______________  
15. sin = .29237 " ______________  
16. sin = .50000 " ______________  
17. tan = 1.3270 " ______________  
18. tan = .72654 " ______________  
19. cos = .65166 " ______________  
20. sin = .83469 " ______________
## Applied Mathematics II

**Evaluation sheet for: Unit VII - Use of Trig. Tables**

<table>
<thead>
<tr>
<th>Lesson #</th>
<th>Title</th>
<th>Level</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Finding the Ratio Correspond-</td>
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<td></td>
<td>ing to a Given Angle</td>
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<tr>
<td>2</td>
<td>Finding an Angle Correspond-</td>
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<td>ing to a Given Function</td>
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<td>3</td>
<td>Unit Test</td>
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</tbody>
</table>

**Evaluation:**

- **A** - I:sson 25%
- **B** - Quiz 25%
- **C** - Test 50%
- **D** - Unit Grade

Date completed __________________
Specific Performances

Unit VIII - Solution of Right Triangles

Lesson 1. Obtaining Expressions

a. Cross multiplies the function of the angle times the denominator of the ratio.
Sets the numerator equal to the above cross-multiplication.

Assignments

Develop the twelve expressions for angles A and B on a 3x5 card.
Example:

\[ \sin A = \frac{\text{OPP}}{\text{HYP}} = \frac{a}{c} \]

\[ \therefore a = \sin A \times c \]

The symbol (:) means therefore.

Keep this card for continuing use!

b. Quiz – Lesson 1 (Closed book)
MACHINE SHOP MATHEMATICS II

Quiz - Lesson 1, Unit VIII

1. List the six possible ratios (trig. functions) for the angle A as in the example below.

   a. \( \sin A = \frac{\text{opp}}{\text{hyp}} = \frac{a}{c} \)

   b.

   c.

   d.

   e.

   f.

2. Develop an expression for the numerators of each ratio above. Write your answer in the space provided.

   Example:

   \( \sin A = \frac{\text{opp}}{\text{hyp}} = \frac{a}{c} \quad (\therefore a = \sin A \times c) \)

   a.

   b.

   c.

   d.

   e.

   f.
Specific Performances

Unit VIII - Continued

Lesson 2. Solving Triangles Given an Angle and One Side

a. Finds the unknown angle.
   Subtracts the given angle from 90°.

b. Finds the unknown side and hypotenuse.
   Employs the appropriate expression from Lesson 1.

Lesson 3. Solving Triangles Given Two Sides

a. Finds one unknown angle.
   Finds the tangent ratio of the sides and locates the corresponding angle in the trig. tables.

b. Finds the second unknown angle as in Lesson 2 above.

c. Finds the hypotenuse.
   After solving for one angle, completes as in Lesson 2.

Assignments

   Solve for the unknown angle in prob. 1-10, pp. 289-290.


a. Math for V & T Schools, p. 290, see solution of Angle A
   Solve for Angle A, problems 1-10, set B, p. 291.

b. Math for V & T Schools, p. 290, see solution of Angle B
   Solve for Angle B, problems 1-10, set B p. 291.

c. Math for V & T Schools, p. 291, problems 1-10, set B

d. Quiz - Lessons 2 and 3
MACHINE SHOP MATHEMATICS II

Quiz – Lessons 2 & 3, Unit VIII

Fill in the missing information. Use your cards of trig. functions and expressions, also the Machinery’s Handbook for trig. tables.

---- Use three place decimals in answers.

---- Work to the nearest minute of angle.

<table>
<thead>
<tr>
<th>Side a</th>
<th>Side b</th>
<th>Side c</th>
<th>Angle A</th>
<th>Angle B</th>
</tr>
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<tbody>
<tr>
<td>7.000</td>
<td></td>
<td></td>
<td>24°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.625</td>
<td></td>
<td></td>
<td>30°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.500</td>
<td></td>
<td>60°</td>
</tr>
<tr>
<td>.625</td>
<td>.125</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.500</td>
<td>2.500</td>
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</tbody>
</table>
Lesson 4. Solving Triangles Given One Side and the Hypotenuse

a. Finds one unknown angle. Employs the appropriate function of either sine or cosine to find the ratio and locates the corresponding angle in the trig. tables.

b. Finds the second unknown angle. Solves as in the previous problems.

c. Finds the unknown side. Employs the appropriate expression from Lesson 1.

Lesson 5 - Unit Test

a. Math for V & T Schools, p. 291, see example 3 for Angle A. Solve for angle A in problems 1-10, set C

b. Math for V & T Schools, p. 291, see example 3 for Angle B. Solve for angle B in problems 1-10, set C.

c. Math for V & T Schools, p. 291, solve for the unknown side in problems 1-10, set C.

Handout - Unit Test
Find the missing parts using the information given.
Use your cards of trig. functions and expressions to solve.
Use your Machinery's Handbook for the Trig. tables.
Answers to be three-place decimals.

Seven (7) points each part

<table>
<thead>
<tr>
<th>Side a</th>
<th>Side b</th>
<th>Hypotenuse</th>
<th>Angle A</th>
<th>Angle B</th>
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<tr>
<td></td>
<td></td>
<td>3.500</td>
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<td>2.125</td>
<td></td>
<td></td>
<td></td>
<td>60°</td>
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<td></td>
<td></td>
<td>6.187</td>
<td></td>
<td>10°15'</td>
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<tr>
<td>.875</td>
<td>1.000</td>
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<td></td>
<td></td>
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<tr>
<td>4.250</td>
<td>15.625</td>
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<tr>
<td>1</td>
<td>Obtaining Expressions</td>
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<td>Quiz - Lesson 1</td>
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<td>2</td>
<td>Solving Triangles Given an Angle and One Side</td>
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<td>3</td>
<td>Solving Triangles Given Two Sides</td>
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<td></td>
<td>Quiz - Lessons 2 and 3</td>
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<td>4</td>
<td>Solving Triangles Given One Side and the Hypotenuse</td>
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Evaluation:

A B C D

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed
Specific Performances

Unit IX - Practical Applications of Trigonometry

Lesson 1. Introduction to Taper Angles

a. Defines the taper angle as the included angle formed either by the prolongation of the sides of tapered work or by the joining of sides of tapered work.

Assignments


Lesson 2. Computing the Taper Angle given Large and Small Diameters.

a. Draws a line parallel to the center line from the small diameter to the larger diameter forming a right triangle equal to half the taper angle.

b. Solves for the angle formed by the right triangle using the appropriate trig. function. Doubles this angle to find the included (taper) angle.

Assignments

a. Math for V & T Schools, p. 335, example 1. Make a sketch of fig. 238 showing the right triangle formed.

Lesson 3. Computing the Taper Angle given Taper per Foot.

a. Forms a right triangle as in Lesson 2. Finds the triangle altitude by taking one-half the taper per foot. Gives the length of the triangle base as 12 inches.

b. Solves for one-half the taper angle using the above triangle and the appropriate trig. function. Doubles this angle to find the included (taper) angle.

Assignments

a. Math for V & T Schools, p. 336, example 2. Make a sketch of fig. 239. Work the solution yourself; compare your answer with the text.

b. Math for V & T Schools, p. 337. Work problem #1, p. 337, #14, p. 329, #15-21

c. Quiz - Lessons 2 and 3
Mathematics for Vocational & Technical Schools:

Figure 234 on page 334 has a Brown and Sharpe Taper.

Find:

a. Small diameter "d" to three decimal places.

b. The taper angle to the nearest minute of angle.
Unit IX - Continued

Lesson 4. Problems Involving Isosceles Triangles

a. Drops a perpendicular line from the vertex angle to the base dividing the isosceles triangle into two equal right triangles.

b. Uses the information given and the appropriate trig. procedure to find the vertex angle, altitude and base.

c. Applies the theory of isosceles triangles to the solution of common shop problems.

Lesson 5. Problems Involving the Sine Bar in Inspection and Set-Up Work

a. Uses the sine tables to find the height of gage blocks needed to raise a 5-inch sine bar to a given angle.

b. Uses the table of sines to determine the angle being measured when the height of the sine bar is known.

Lesson 6 - Unit Test

a. Math for V & T Schools, pp. 292-294, examples 1 and 2


Lesson 6 - Unit Test

a. Machinery's Handbook. Look up sine-bar in index. Find the gage-block height for the following angles:

   1. 45°00'  6. 12°30'
   2. 30°00'  7. 29°51'
   3. 10°18'  8. 42°50'30"
   4. 17°21'  9. 22°12'15"
   5. 42°58' 10. 15°1'45"

b. Machinery's Handbook. Find the angle corresponding to the height of the sine bar below:

   1. 3.5356  6. 2.5752
   2. 2.5000  7. 0.26170
   3. 3.3801  8. 1.0815
   4. 2.2687  9. 1.295
   5. 0.579  10. 3.105

Handout Unit Test
MACHINE SHOP MATHEMATICS II

Unit IX - Test

1. A taper pin 3 inches long measures .500 at its large diameter and .375 at the small diameter. What is its taper angle?

2. A shaft tapers down to .750 diameter and has a taper per foot of .250 inches. How long is the tapered portion?

3. Six holes are to be laid out on a 10-inch circle. What is the center-to-center distance of each pair?

4. To what height must a 5-inch sine bar be raised, to give an angle of exactly 30°?

5. A 5-inch sine bar must be raised to exactly 1.29410 inches to level a piece being inspected for its angle. What angle does the inspection show?

6. Extra credit: To what height must a 10-inch bar be raised in problem #4?
<table>
<thead>
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<td>1</td>
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<tr>
<td>2</td>
<td>Computing the Taper Angle Given the Large and Small Diameters</td>
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<td>3</td>
<td>Computing the Taper Angle Given Taper per Foot</td>
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Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed
Specific Performances

Unit X - Computing Taper per Unit of Length

Lesson 1. Computing Taper and Diameter

a. Converts taper per inch to any other length in inches.
   Assignment: Math for V&T Schools, pp. 324-325, see example 1.

b. Finds taper per inch (TPI) given taper per foot:
   \[ TPI = \frac{TPF}{12} \]
   Assignment: Math for V&T Schools, p. 326, see example 2. Work problems 1-2, pp. 328-329.

c. Finds the taper per foot (TPF) given large and small diameters:
   \[ TPF = TPI \times 12 \text{ or } TPF = \frac{D-d}{\ell} \times 12 \]
   Assignment: Math for V&T Schools, p. 326, see example 3. Work problems 5-7, 9-11 p. 329.

d. Finds the small diameter (d) given TPF, D, and \( \ell \):
   \[
   \begin{align*}
   \text{taper} & = D - d \\
   d & = D - \text{taper} \\
   d & = D - \frac{TPF \times \ell}{12}
   \end{align*}
   \]

e. Finds the large diameter given \( \ell \), d, and TPI:
   \[
   \begin{align*}
   \text{taper} & = D - d \\
   D & = d + \text{taper} \\
   D & = d + (\ell \times \text{TPI})
   \end{align*}
   \]
   Assignment: Math for V&T Schools, p. 327, see example 5. Work problems 15,17,20

Lesson 2 - Unit Test

Hand out Unit X Test A
Use the illustrations from the text: Mathematics for Vocational and Technical Schools pages 329 - 334.

1. Compute the small diameter of the lathe center in Fig. 220. The taper is Morse #3.

2. Compute the taper per inch and taper per foot on the mandrel in Fig. 228.
   \[ 2. \text{TPI} = \]
   \[ 2. \text{TPF} = \]

3. Find the small diameter in Fig. 234. Taper is #4 Morse.

4. The adapter in Fig. 231 has a 1/4-inch wall thickness and a #4 Morse taper. Find the large diameter of the outside taper.

\[ 4. \]
<table>
<thead>
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Evaluation:

Lesson 25%
Quiz 25%
Test 50%
Unit Grade

Date completed ________________________