Practical Problems in Mathematics for Electricians 9th Edition Herman Solutions Manual
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Instructor's Guide to Accompany

Practical Problems in Mathematics for Electricians

Ninth Edition

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Instructor's Guide to Accompany Practical Problems in Mathematics for Electricians, 9e
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1 2 3 4 5 6 7 14 13 12 11 10

CONTENTS

	To the Instructor	v
	Section 1 Whole Numbers	
Unit 1	Addition of Whole Numbers	1
Unit 2	Subtraction of Whole Numbers	1
Unit 3	Multiplication of Whole Numbers	2
Unit 4	Division of Whole Numbers	3
Unit 5	Combined Operations with Whole Numbers	4
	Section 2 Common Fractions	
Unit 6	Addition of Common Fractions	5
Unit 7	Subtraction of Common Fractions	5
Unit 8	Multiplication of Common Fractions	6
Unit 9	Division of Common Fractions	7
Unit 10	Combined Operations with Common Fractions	7
	Section 3 Decimal Fractions	
Unit 11	Addition of Decimal Fractions	9
Unit 12	Subtraction of Decimal Fractions	9
Unit 13	Multiplication of Decimal Fractions	10
Unit 14	Division of Decimal Fractions	11
Unit 15	Decimal and Common Fraction Equivalents	12
Unit 16	Combined Operations with Decimal Fractions	12
	Section 4 Percents, Averages, and Estimates	
Unit 17	Percent and Percentage	13
Unit 18	Interest	13
Unit 19	Discount	14
Unit 20	Averages and Estimates	14
Unit 21	Combined Problems on Percents, Averages, and Estimates	15
	Section 5 Powers and Roots	
Unit 22	Powers	16
Unit 23	Roots	17
Unit 24	Combined Operations with Powers and Roots	17
Unit 25	Metric Measure and Scientific Notation	18
	Section 6 Measure	
Unit 26	Length Measure	18
Unit 27	Area Measure	19
Unit 28	Volume and Mass Measure	20
Unit 29	Energy and Temperature Measure	21
Unit 30	Combined Problems on Measure	22
	Section 7 Ratio and Proportion	
Unit 31	Ratio	23
Unit 32	Proportion	24
Unit 33	Combined Operations with Ratio and Proportion	24

Section 8 Formulas

Unit 34 Representation in Formulas 25
Unit 35 Rearrangement in Formulas 25
Unit 36 General Simple Formulas 26
Unit 37 Ohm's Law Formulas 27
Unit 38 Power Formulas 28
Unit 39 Combined Problems on Formulas 28

Section 9 Trigonometry

Unit 40 Right Triangles 29
Unit 41 Trigonometric Functions 30
Unit 42 Plane Vectors 30
Unit 43 Rotating Vectors 31
Unit 44 Combined Problems in Trigonometry 32
Unit 45 Number Systems 32

Achievement Reviews

Achievement Review A 33
Achievement Review B 35
Answers to Achievement Review A 38
Answers to Achievement Review B 39

TO THE INSTRUCTOR

This text and instructor's guide are designed to help your students learn mathematics. Explanations are provided for the benefit of the student as well as the new teacher.

READING A TEXTBOOK

In preparation for the use of any text, the student should be able to observe the particular aids provided. For example, encourage the student to answer some of these questions:

1. What does the Table of Contents tell me about the areas covered in this book?
2. When was this book copyrighted? Why is this important?
3. What is the difference between a section and a unit?
4. Does this book have spaces for me to write the answers or do I always need my own paper and pencil? Where can I do my figuring?
5. Does this book have an Index? Glossary? Appendix? If not, why not? If so, what information is available in them? When do I need to use them?
6. Is there an answer key available?

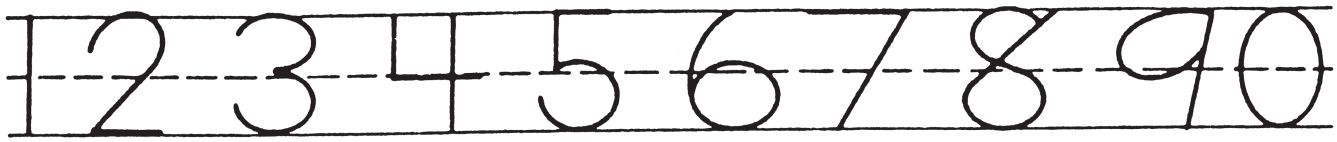
READING AND WRITING MATHEMATICS

Reading a mathematics textbook requires different skills than reading a novel. Students should be encouraged to develop some special skills. They should be made aware of the specialized vocabulary and its meaning in mathematical problems.

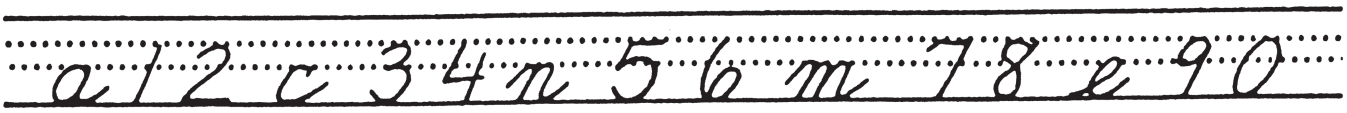
The following steps are strongly recommended for the improvement of mathematical reading ability:

1. Read the whole problem to find out what it is about.
2. Look for the question or direction that tells what to find or what to do.
3. Look carefully at the problem to determine the facts that are given.
   a. Discard irrelevant facts.
   b. Be sure of the meaning of all words, specially mathematical terms.
   c. Consider any conversions necessary, such as feet to inches, inches to meters, etc.
4. Plan the steps necessary in order to arrive at the answer.
   a. Are any special computing devices or tools needed, such as a calculator, steel rule, or a micrometer?
   b. Are any other facts necessary, such as those found in the Appendix?
   c. Does a drawing help to relate the facts to one another?
   d. Look carefully at the drawing, making sure all information is interpreted and obtained corrected for use in the problem.
5. Prepare the given information
   a. Relate the facts in a word statement.
   b. Write the numbers, formulas, or symbols necessary.
   c. Estimate the answer.
6. Use numbers in the mathematical relationship, and compute the necessary information. Round final answers as directed.
7. Verify the answer.
   a. Check the problem by checking the arithmetic processes.
   b. Does the final answer agree with the estimate?
   c. Does the answer sound reasonable for the situation originally described?
   d. Is the answer in the proper units or terminology?

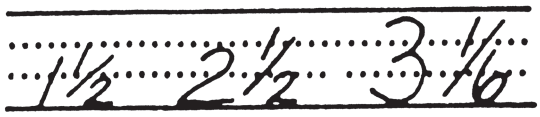
The writing of numbers so they can be easily read is very necessary in any mathematical work. It is recommended that students be given frequent drill and practice in the proper formation of the following figures:



When letters and figures are written together, the figures should be one-half again as high as the one-space letters. For example,



Fractions are written with the figures smaller than the whole numbers, but they must be large enough for easy reading. For example,



Special Note

1. Answers to some questions may vary according to certain values. For example, pi (π) may be used as 3.14, $\frac{22}{7}$, or 3.1416.
2. Rounding values before the final answer may result in a slightly different answer.

OCCUPATIONS AND RESOURCES

Very often students ask questions or need help in areas with which a teacher is not familiar. This information about occupations and resources is provided to assist the teacher in helping these students.

Occupational Information

In today's world, there is a great emphasis on career awareness and specialization. In electronics, as in any career, the student should be aware of personal qualifications, working conditions, employment outlook, and required job entry skills.

This information is a summary of the relevant facts pertaining to the field of electronics. It serves as a review for the experienced electronics instructor and as an introduction for the instructor who is not fully acquainted with the field. Further details can be found in various books including the *Dictionary of Occupational Titles* and the *Occupational Outlook Handbook.*

Nature of Electrical Work. Careers in the electricity field are usually divided into those dealing with construction and those dealing with maintenance.

Construction electricians assemble, install, and wire electrical systems for heat, light, power, air-conditioning, and refrigeration components of construction. They may also install electrical machinery, electronic equipment, controls, and signals and communications systems. Construction electricians follow blueprints and specifications, may be involved in bending and fitting conduits, and complete circuits between outlets and switches.

Maintenance electricians maintain the systems that construction electricians install. They keep lighting systems, transformers, generators, and other electrical equipment in good working order. In large factories, they may be responsible for specific items such as motors and welding machines, while in small factories or in office buildings they may be responsible for all kinds of electrical equipment. The main emphasis of this career is placed on the preventative maintenance, which means keeping equipment in good running order. If a problem does arise, the maintenance electrician must find the cause and make the repairs quickly to prevent costly production losses.

Many electricians are required to provided their own hand tools—such as screwdrivers, pliers, knives, and hacksaws—and must comply with National Electrical Code regulations as well as the requirements set by state, county, and municipal electrical codes.

Working Conditions. Frequently, electricians must stand for long periods of time or work in cramped quarters. The installation or repair of equipment may also require them to stand on ladders and scaffolds and thus be subjected to the possibility of falls. Other occupational hazards include electrical shock and blows from falling objects. Electricians usually work inside and are less exposed to unfavorable weather.

Job Entry Requirements. Although some people learn the trade informally by working as an electrician's helper, the best way to learn the trade is through a four-year apprenticeship program.

Apprenticeship programs are sponsored through and supervised by local union-management committees. The program usually consists of 144 hours of class instruction each year as well as a comprehensive on-the-job training program. Classroom instruction includes courses in blueprint reading, electrical theory, electronics, mathematics, safety, and first aid practices.

Personal qualifications and requirements for entering into an electrician's apprenticeship program include:

18 years of age
high school or vocational school graduate with at least one year of algebra and, preferably, courses in electricity, electronics, mechanical drawing, science, and Industrial Arts
manual dexterity
agility
good physical health
good color vision

Advancement. Graduates of the apprenticeship program, as well as those people who have gained knowledge through trade school, correspondence courses, or special training in the Armed Forces are required in most cities to obtain a license. To obtain this license, a person must pass an examination that requires a thorough knowledge of the craft and of state and local building codes. Experienced electricians can advance to supervisors and superintendents. Electricians may also start their own business but this may involve obtaining a master electrician's license. Construction electricians may also become contract estimators for contractors on construction jobs.

Employment Outlook. Employment in the electrical field is expected to increase through the 21st century. In the construction electrical field, there may be fluctuations from year to year due to ups and downs in construction. When construction jobs are not plentiful, construction electricians may transfer to other types of electrical work. For example, the construction electricians may work in the maintenance field, which will be increasing due to the use of electrical and electronic equipment.

Curriculum Resources

Course development is rapidly changing and expanding and, with it, new resources for instructional materials have developed. These resources allow teachers to strengthen and increase their knowledge on a subject while updating and reconstructing their instructional programs. In the area of electricity, there are many forms of curriculum resources that aid both the teacher and the student.

Trade and Professional Organization. A teacher can gain substantial knowledge from trade and professional organizations. These organizations offer a variety of services and resource information and also acquaint a teacher with developments in the field of electricity. Additional information concerning these organizations can be secured by writing directly to the organization.

International Brotherhood of Electrical Workers
1125 15th St. NW
Washington, DC 20005

National Electrical Contractors Association
1730 Rhode Island Ave. NW
Washington, DC 20036

National Joint Apprenticeship and Training Committee for the Electrical Industry
1730 Rhode Island Ave. NW
Washington, DC 20036

SECTION 1 WHOLE NUMBERS

UNIT 1 Addition of Whole Numbers

1. 176 + 264 + 375 + 234 + 116 = 1,165
2. 124 + 72 + 36 + 92 + 38 + 64 + 74 + 67 = 567
3. 68 + 58 + 89 + 84 + 72 + 59 + 69 + 57 = 556
4. 56 + 9 + 86 + 36 + 93 + 105 + 42 + 56 = 483
5. $118 + $38 + $64 + $88 + $73 + $26 + $153 + $112 + $215 + $64 = $951
6. 500 ft + 1,200 ft + 250 ft + 90 ft + 38 ft + 65 ft + 84 ft + 225 ft + 125 ft = 2,577 ft
7. 625 ft + 785 ft + 75 ft + 140 ft + 310 ft + 325 ft + 120 ft = 2,380 ft
8. 75 hp + 30 hp + 200 hp + 40 hp + 25 hp + 15 hp + 5 hp + 125 hp + 150 hp + 175 hp = 840 hp
9. 35 lb + 40 lb + 125 lb + 200 lb + 75 lb + 90 lb + 20 lb + 30 lb = 615 lb
10. 450 kW • h + 400 kW • h + 420 kW • h + 380 kW • h + 370 kW • h + 320 kW • h + 310 kW • h + 330 kW • h + 380 kW • h + 400 kW • h + 420 kW • h + 580 kW • h = 4,760 kW • h
11. 545 W + 650 W + 750 W + 1,820 W + 2,462 W + 2,571 W + 1,360 W + 1,540 W + 793 W + 1,225 W + 330 W + 793 W = 14,839 W
12. $58 + $55 + $51 + $19 + $24 = $207
13. 325 + 45 + 18 + 25 + 30 + 24 + 6 = 473
14. 150 W + 125 W + 75 W = 350 W
15. 250 + 125 + 65 + 36 + 48 + 96 + 92 + 28 + 42 + 106 + 140 + 24 = 1,052
16. 7,500 ft + 10,750 ft + 4,500 ft = 22,750 ft
17. 1,200 ft + 1,150 ft + 1,076 ft + 180 ft + 100 ft = 3,706 ft

1. 1,165
2. 567
3. 556
4. 483
5. $951
6. 2,577 ft
7. 2,380 ft
8. 840 hp
9. 615 lb
10. 4,760 kW • h
11. 14,839 W
12. $207
13. 473
14. 350 W
15. 1,052
16. 22,750 ft
17. 3,706 ft

UNIT 2 Subtraction of Whole Numbers

1. 500 ft + 250 ft + 750 ft = 1,500 ft
   1,500 ft – 339 ft = 1,161 ft
2. $598 – $263 – $173 – $10 = $152
3. 145 – 35 = 110
   565 – 110 = 455
4. 45 ft + 45 ft + 45 ft + 65 ft + 65 ft + 65 ft = 330 ft
   1,050 ft – 330 ft = 720 ft
5. 30 ft + 15 ft + 8 ft + 25 ft + 15 ft + 20 ft = 81 ft
   250 ft – 113 ft = 137 ft
6. 365 lb + 422 lb = 787 lb
   1,106 lb – 787 lb = 319 lb
7. 1,365 ft + 830 ft = 2,195 ft
   2,500 ft – 2,195 ft = 305 ft
8. $76 + $105 = $181
   $438 – $181 = $257
9. 59 + 69 + 72 = 200
   400 – 200 = 200
10. 15 lb + 6 lb + 24 lb + 12 lb + 3 lb + 8 lb + 17 lb + 32 lb + 16 lb + 13 lb = 146 lb
    435 lb – 146 lb = 289 lb
11. 1,876 kW • h – 504 kW • h = 1,372 kW • h

1. 1,161 ft
2. $152
3. 455
4. 720 ft
5. 137 ft
6. 319 lb
7. 305 ft
8. $257
9. 200
10. 289 lb
11. 1,372 kW • h
12. 655
13. 65
14. 8
15. 221 ft
16. 127 mi
17. 10 MΩ
18. 88 cm

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12. $14 + 75 = 89$
    $804 - 60 = 744$
    $744 - 89 = 655$
13. $47 + 65 = 112$
    $112 - 4 = 108$
    $173 - 108 = 65$
14. $10 + 12 + 20 + 20 = 62$
    $70 - 62 = 8$
15. $250 \text{ ft} - 29 \text{ ft} = 221 \text{ ft}$
16. $134 \text{ mi} - 7 \text{ mi} = 127 \text{ mi}$
17. $14 \text{ M}\Omega + 25 \text{ M}\Omega + 11 \text{ M}\Omega = 50 \text{ M}\Omega$
    $60 \text{ M}\Omega - 50 \text{ M}\Omega = 10 \text{ M}\Omega$
18. $189 \text{ cm} - 101 \text{ cm} = 88 \text{ cm}$

UNIT 3 Multiplication of Whole Numbers

1. a. $3 \times 16 = 48$
   b. $3 \times 21 = 63$
   c. $3 \times 11 = 33$
   d. $2 \times 16 = 32$
   e. $2 \times 21 = 42$
   f. $2 \times 11 = 22$
2. $\frac{40,500 \text{ r}}{\text{hr}} \times \frac{8 \text{ hr}}{1} = 324,000 \text{ r}$
3. $5 \text{ hp} + 7 \text{ hp} + 10 \text{ hp} = 22 \text{ hp}$
   $\frac{22 \text{ hp}}{1} \times \frac{746 \text{ W}}{1 \text{ hp}} = 16,412 \text{ W}$
4. $\frac{97 \text{ layers}}{1} \times \frac{215 \text{ turns}}{\text{layer}} = 20,855 \text{ turns}$
5. $\frac{20 \text{ layers}}{1} \times \frac{143 \text{ turns}}{\text{layer}} = 2,860 \text{ turns}$
   No. (2,860 turns will not satisfy the required 2,900 turns.)
6. $16 \times 50 \text{ W} = 800 \text{ W}$
   $9 \times 15 \text{ W} = 135 \text{ W}$
   $12 \times 25 \text{ W} = 300 \text{ W}$
   $6 \times 75 \text{ W} = 450 \text{ W}$
   $4 \times 100 \text{ W} = 400 \text{ W}$
   $2,085 \text{ W}$
7. $10 \times 150 \text{ W} = 1,500 \text{ W}$
   $8 \times 60 \text{ W} = 480 \text{ W}$
   $= 1,980 \text{ W}$
8. $34 \text{ boxes} - 23 \text{ boxes} = 11 \text{ boxes}$
   $\frac{11 \text{ boxes}}{1} \times \frac{8 \text{ holes}}{\text{box}} = 88 \text{ holes}$
   $\frac{23 \text{ boxes}}{1} \times \frac{7 \text{ holes}}{\text{box}} = 161 \text{ holes}$
   $88 \text{ holes} + 161 \text{ holes} = 249 \text{ holes}$
9. $7 \text{ people} \times \$18 \times 40 \text{ hours} = \$5,040$
   $11 \text{ people} \times \$20 \times 40 \text{ hours} = \$8,800$
   $9 \text{ people} \times \$16 \times 40 \text{ hours} = \$5,760$
   $\$5,040 + \$8,800 + \$5,760 = \$19,600$

1. a. 48
   b. 63
   c. 33
   d. 32
   e. 42
   f. 22
2. 324,000 r
3. 16,412 W
4. 20,855 turns
5. No
6. 2,085 W
7. 1,980 W
8. 249 holes
9. $19,600
10. 1,800 W
11. 1,940 W
12. $667
13. 220 circuits
14. 3,815 ft

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