
Introduction

EXAM FORMAT

The Principles and Practice of Engineering examination (PE exam) in mechanical engineering is an 8-hour exam divided into a morning and an afternoon session. The morning session is known as the “breadth” exam and the afternoon is known as the “depth” exam.

The morning session includes 40 problems from all three areas of mechanical engineering: HVAC and refrigeration, mechanical systems and materials, and thermal and fluids systems. The three areas are roughly equally represented. As the “breadth” designation implies, morning session problems are general in nature and wide-ranging in scope.

The afternoon session allows the examinee to select a “depth” exam module from one of the three subdisciplines. The 40 problems included in the afternoon session require more specialized knowledge than those in the morning session.

All problems from both the morning and afternoon sessions are multiple choice. They include a problem statement with all required defining information, followed by four logical choices. Only one of the four options is correct. Problems are generally self-contained and independent, so an incorrect choice on one problem typically will not carry over to subsequent problems.

Topics and the approximate distribution of problems on the afternoon session of the mechanical systems and materials exam are as follows.

Principles: about 60% of exam problems

- Statics, kinematics, dynamics, materials properties, and strength of materials

Applications: about 40% of exam problems

- Mechanical Components: pressure vessels; bearings; gears; springs, belts, pulleys, and chains; clutches and brakes; power screws; shafts and keys; mechanisms; mechatronics
- Joints and Fasteners: welding and brazing; bolts, screws, and rivets; adhesives and soldering; other joints and fasteners
- Vibration/Dynamic Analysis: natural frequencies; damping; forced vibrations; vibration isolation; dynamic analysis

- Materials and Process: materials selection; manufacturing processes; fits and tolerances; economic analysis; and project management

For further information and tips on how to prepare for the mechanical engineering PE exam, consult the *Mechanical Engineering Reference Manual* or PPI’s website, www.ppi2pass.com.

THIS BOOK’S ORGANIZATION

Six-Minute Solutions for Mechanical PE Exam Mechanical Systems and Materials Design Problems is organized into two sections. The first section, Breadth Problems, presents 19 problems in machine design of the type that would be expected in the morning part of the mechanical engineering PE exam. The second section, Depth Problems, presents 66 problems typical of the afternoon part of this exam. These two sections of the book are further subdivided into the specific topic areas covered by the mechanical systems and materials exam.

Most of the problems are quantitative, requiring calculations to arrive at a correct solution. A few are non-quantitative. Some problems will require a little more than 6 minutes to answer and others a little less. On average, you should expect to complete 80 problems in 480 minutes (8 hours), or spend 6 minutes per problem.

Six-Minute Solutions for Mechanical PE Exam Mechanical Systems and Materials Problems does not include problems related directly to HVAC and refrigeration, nor to thermal and fluids systems, although problems from these subdisciplines will be included in the mechanical systems and materials exam, particularly in the morning session. Other books in the *Six-Minute Solutions* series provide problems for review in these areas.

HOW TO USE THIS BOOK

Each problem statement in this book, with its supporting information and answer choices, is presented in the same format as the problems encountered on the PE exam. The solutions explain step by step how the answer is logically derived, to help you follow the reasoning and to provide examples of how you may want to approach your solutions as you take the PE exam.

Each problem includes a hint to provide direction in solving the problem. In addition to the correct solution, you will find an explanation of the faulty reasoning leading to the three incorrect answer choices. The incorrect answers are chosen to show some common mistakes made when solving each type of problem. These may be simple mathematical errors, such as failing to square a term in an equation, or more serious errors, such as using the wrong equation.

To optimize your study time and obtain the maximum benefit from the practice problems, consider the following suggestions.

1. Complete an overall review of the problems and identify the subjects that you are least familiar with. Work a few of these problems to assess your general understanding of the subjects and to identify your strengths and weaknesses.
2. Locate and organize relevant resource materials. (See the references section of this book as a starting point.) As you work problems, some of these resources will emerge as more useful to you than others. These are what you will want to have on hand when taking the PE exam.
3. Work the problems in one subject area at a time, starting with the subject areas that you have the most difficulty with.
4. When possible, work problems without using the hint. Always attempt your own solution before looking at the solutions provided in the book. Use the solutions to check your work or to provide guidance in finding solutions to the more difficult problems. Use the incorrect solutions to help identify pitfalls and to develop strategies to avoid them.
5. Use each subject area's solutions as a guide to understanding general problem-solving approaches. Although problems identical to those presented in this book will not be encountered on the PE exam, the approach to solving problems will be the same.

Solutions presented for each example problem may represent only one of several methods for obtaining a correct answer. Although we have tried to prepare problems with unique solutions, alternative problem-solving methods may occasionally produce a different, but nonetheless appropriate, answer.