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PLUMBING LICENSING

Exam Guide

FOURTH EDITION

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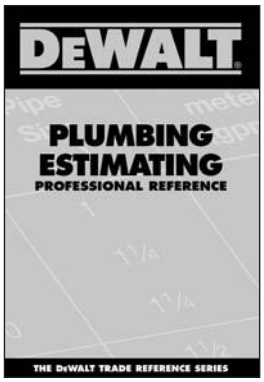

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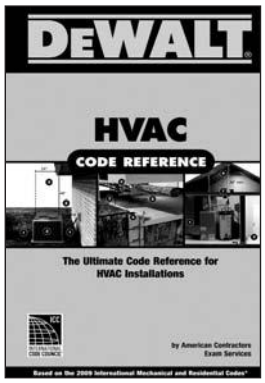

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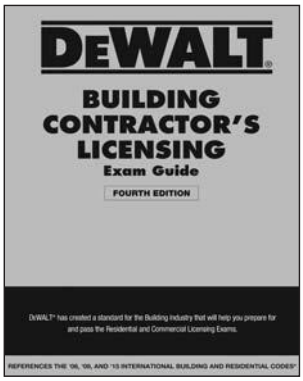

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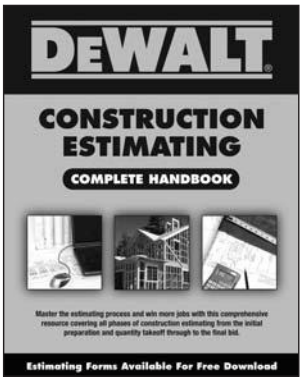

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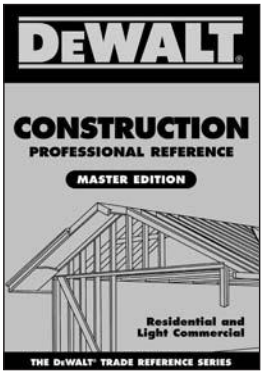

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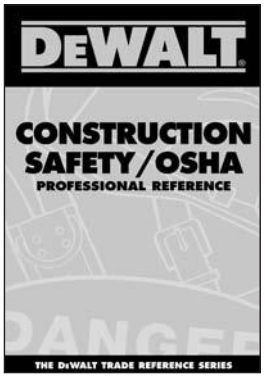

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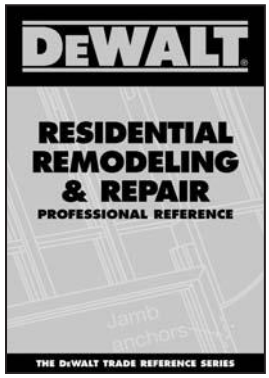

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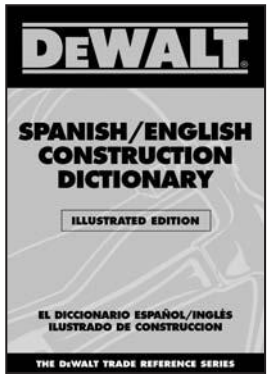

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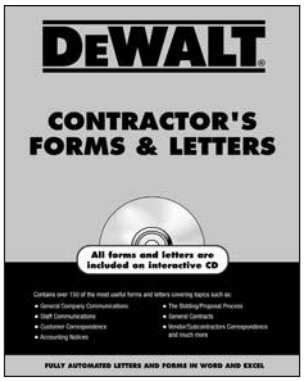

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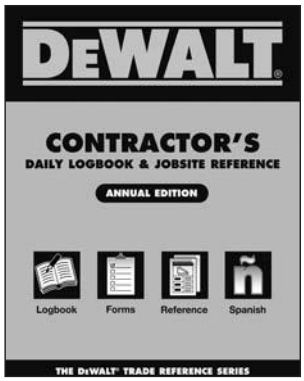

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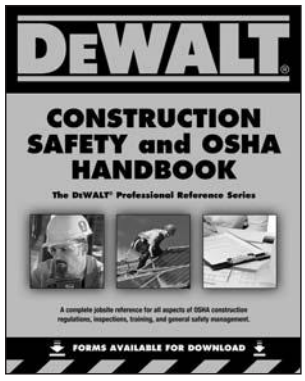

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FOURTH EDITION

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Chris Prince

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Cengage Learning
20 Channel Center Street
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INTRODUCTION

Congratulations! If you are reading this book, it is likely you are pursuing a new opportunity. Whether you are preparing to take an exam in order to start your own plumbing business, to enhance the qualifications of an existing company, or to qualify the company for which you now work, you are taking deliberate measures to improve an existing situation. So sit back, relax, and rest assured, the time you spend with this book will significantly improve your chances of passing the exam you are about to take.

TIME FOR TEST MODE

Preparing for and taking an exam requires a specific mindset. It requires planning for the upcoming event and making a conscious effort to control your anxiety. For most, the mere thought of taking an exam will cause at least a feeling of butterflies churning in the stomach. Some may even react more severely. Don't fear, controlled test anxiety is good. It creates a sense of urgency to succeed. Identify your level of anxiety and control it.

How do you rate your level of anxiety? For some, perhaps the last test-taking ordeal was a high school final exam many years ago. The memory of this experience, coupled with the pressure of living up to the expectations of family, boss, or coworkers, can be overwhelming. When children are aware that a parent will soon be taking an exam, they are likely to reciprocate the pressure applied to do well in school. Bosses often assume the exam will be a breeze for such a competent employee. Many times, a spouse's support is mistaken for unrealistic expectation. Peer pressure is not necessary. Do what you can to minimize it.

The pressures felt from the need to please and live up to the expectations of everyone around you can lead to undue stress and are not necessary. Simply keep the fact that you are taking the exam a secret! Maybe everyone notices your study efforts but there is no need to announce the test date. Make your plans by scheduling the exam, and if you must explain, simply say you have an appointment. If no one knows your plans, the only pressure you will feel to succeed is your own. This pressure is healthy and probably necessary. Rather than dealing with the pressure of others, imagine the feeling when you announce your accomplishment after the fact. Work toward this goal and visualize success. Think positive.

Another way to eliminate stress may be to think of your first test date as a practice run. The worst-case scenario is that passing the exam will take two attempts. The simple fact of the matter: It is not the end

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of the world if you do not pass on the first attempt. Most states and municipalities allow you to take the exam as many times as necessary without penalty. Make sure you are not limited by the number of times you can take an exam before using this suggestion. (We will explain later how to check this.)

Next, avoid becoming irritated that the exam is required. Forget the fact that you know your trade and feel you should not be required to pass an exam to prove yourself. Look at the experience as an opportunity. The knowledge you gain from preparing for the exam will far outweigh the effort. Without a doubt, you will gain information that will improve your efficiency and trade expertise and could even save you money.

Remember the old carpenter's advice to measure twice and cut once? Similarly, when it comes to test-taking, it is critical to be precise, careful, and methodical as you prepare for exam day. Apply this philosophy as you take the practice exams in this book—read the question twice and choose the answer carefully. The exams are typically administered in a multiple-choice format and it is not uncommon for at least two of the choices to appear correct, depending on how the question is read. Remember, there is only one correct answer. One word in the question can change the entire meaning of the question. Be careful.

After you have switched to test mode, it is time to begin preparing for the exam.

PREPARING FOR THE EXAM

The first step of preparation is to identify the exam required to accomplish your goal. If you are taking a state-required exam to become a licensed contractor, begin by visiting www.becomealicensedcontractor.com. Select your state, choose plumbing under the listing of test types, and the test requirements will be found. The site will likely lead you to the candidate bulletin provided by the approved testing company.

The candidate bulletin is the test-taker's rulebook. It provides specific information including the addresses of testing centers, identification requirements, security procedures, and anything else necessary for taking the exam. In preparing for the exam, it is important to identify the answers to the following questions using the candidate information bulletin:

1. **What are the approved references?** This is, by far, the most important piece of information to know prior to beginning your exam preparation mission. Most plumbing exams are based on

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both the *International Plumbing Code*® and the *International Gas Code*®. In addition, many exams include content that will be found in an OSHA Standards Part 1926 book, a plumbing theory book, and a project management book. After identifying the approved reference materials, you can eliminate the study exams in this book that are not included in your exam. Do not spend valuable time studying information that is not included on your exam.

2. **Are the approved references allowed into the examination center?** In most cases the books are allowed in the examination room to be available to you throughout the exam. While it would seem to make the exam extremely easy, if you are not familiar with how to use the books, it might as well be a closed-book exam.
3. **Is tabbing and highlighting of the books allowed?** Typically, if the approved references are allowed to be taken into the exam room, they are allowed to be highlighted and tabbed prior to test day. Many rules allow you to underline but prohibit you from making notes in the reference materials. The candidate bulletin will specifically call for permanent tabs. Permanent tabs are those which cannot be easily removed. Post-It® tabs are generally not allowed. If any of the rules are broken, your reference materials can be banned from the test site.
4. **What is the time frame for taking the exam?** This is very important because you will want to simulate the time allowed as you work through the study exams throughout this book. Simply take the allotted time in minutes and divide by the number of questions on the exam to determine the time allotment per question. You can now easily multiply the number of questions in a particular section of this book by the average time allowed per question to set the time frame for working through the practice exams. In the beginning, you will want to allot additional time until you become familiar with the reference materials.
5. **What is the content outline of the exam?** It is important to pay attention to the breakdown of the exam for the purpose of allotting your study time. If only 5 out of 80 questions pertain to OSHA, you should spend less time studying this subject and concentrate more on the areas representing the largest portion of the exam.

USING THIS EXAM GUIDE

Before starting the exam preparation process using this guide, make sure you have highlighters and tabs readily available. Begin by identifying the table of contents, the index, and the glossary of each

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book. Place a tab on each of these sections for easy access. The table of contents will divide the book into chapters or subjects and will be used frequently. The index is an alphabetical listing of key words found throughout the book and should be your starting point for finding an answer to a specific question. If the answer is not found using the index, identify the chapter according to the subject of the question using the table of contents. The glossary is an alphabetized listing of terms and can serve as a useful source for answering questions quickly. A glossary may or may not be found in the approved references.

Each section of this exam guide is based on a particular plumbing subject, general project management information, OSHA regulations, or a chapter of the *International Plumbing Code*® or *International Gas Code*® and is so identified. As you answer each of the questions from the study exam, highlight the answers. This will help you become familiar with the book and will strengthen your ability to quickly reference important code items. Remember, the purpose of each practice exam is not to test your trade knowledge, it is to provide an exercise of how to navigate and use the approved reference(s). If you feel you know the answer to the question, you should verify the answer using the applicable book. Pay very close attention to the tables in the references and the subject matter of each chapter.

When it comes to tabbing your reference materials, be careful not to overdo it. Placing too many tabs throughout your reference materials will serve more as a hindrance than a useful tool. Remember, when using the tabs, the more tabs you use, the longer it will take to read through each one. Using the index will likely save you time in your search for specific information. It is highly recommended that you tab the chapters, table of contents, index, and useful tables.

Going into the exam, make sure you are familiar with the subject matter of each book. It is imperative that you understand the layout and format of each of the references. This is accomplished through the process of answering the questions in this guide.

Prior to exam day, remove the index in any of the approved reference books bound with a three-ring binder, staple it together, and place it in the front pocket of the book. This will allow easy access to the index by being able to place it on the testing table beside the reference rather than requiring you to flip back and forth between the index and the body of the book.

On average, exams allow about 3 minutes per question. When you begin using the study exams in this book, allow yourself between

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8 and 10 minutes per question. As you become more familiar in your use of the reference materials, decrease this time allotment to about 5 minutes. By the time you complete the final exams, allow yourself only the time allotted on your exam.

It is important to immediately devise a time management strategy that works for you. Your goal by test day is to have a plan of action on how to work through the exam. As you are preparing for the exam, keep in mind that the clock will be working against you. Decide the maximum amount of time you will spend on one question before moving on to the next one. You do not want to run out of time.

WHAT TO BRING TO THE EXAM

Prior to test day, make sure you get a good night's rest and arrive armed with the following items:

A copy of the candidate information bulletin. Many times the proctor of the exam is inexperienced. If you are told the tabs are not allowed, you need to be able to defend yourself by referring to the candidate bulletin (the rulebook).

Bottle of water. The clock does not stop during the exam. There are no "hold" buttons. Should you need a sip of water and have to run to the water fountain or bathroom, your timer will continue to count down. Although you have little choice when it comes to a bathroom break, at least be prepared for the dry mouth syndrome.

Magnifying glass. Many of the documents/diagrams used throughout the exam are difficult to read. Save the frustration and headache-causing eyestrain and use a magnifying glass.

Two pencils and a pencil sharpener. Arrive with at least two pencils and a pencil sharpener, especially if you are taking the exam using the old fashioned pencil and paper format. Tests are still administered this way in several states and municipalities.

Two calculators. Remember Murphy's law, if it can go wrong it probably will on test day. Have a contingency plan for everything. If you insist on using your favorite calculator and it happens to be one that you are not sure is allowed, such as a construction master, make sure you have a backup.

A great attitude. Make every attempt to remain calm, cool, and collected. This is easier to maintain if you have adequate rest the night before the exam. Do not cram and stay up until midnight. This will work against your tolerance level for aggravation.

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Remember, frustration will only create tension and make everything more difficult.

Make sure you also understand the requirements for identification, payment methods, and proper exam registration documentation.

LET THE TEST BEGIN

The moment you sit in the "hot seat" to begin the exam, let your strategy unfold. Have a plan and stick with it. A few recommendations:

1. **Switch to Test Mode.** Many times the rules of thumb and the assumptions you make in the field will not work in the test world. While your background and experience can be an asset, don't allow them to get in the way on test day. Make no assumptions. If you are not 100 percent sure about an answer, verify it at some point. Deliberately focus and concentrate on each question.
2. **Arrange your work area neatly.** Stack your books to one side and, if possible, stand them upright so they are each individually accessible. Decide that at least this one day you will be the most organized and careful person in the world.
3. **Download the memory.** That's right, download the information you are having trouble remembering. Transfer the formulas (and anything else you have been repeating since you walked into the test site) from your brain to the scratch paper provided by the proctor.
4. **Become familiar with the construction drawings and/or diagram booklet before you start the clock.** If your test is being administered by computer, you are in control of when the countdown begins. Take advantage of the control, but be careful not to push it. The proctor is only a few steps away and may prod you to begin the test if you wait too long.
5. **Answer the easy questions first.** Nothing will boost your confidence more than to run through a good portion of the exam answering questions based on information you recall from your studies. In contrast, your confidence level can diminish rapidly if you get distracted with a difficult question.
6. **"Mark" any question you answer and have doubt about.** If the test is computer based, you have the option to "mark" questions to review later. If you run out of time, the computer accepts the selected answer and does not penalize you for marking the question. By marking questions, if you have

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additional time after answering all questions, you can verify the answers you selected.

7. **Leave the difficult questions unanswered and come back to these last.** As you skip questions, make a note on the scratch paper associating the question number with a specific book. This will allow you to categorize each of the unanswered questions by book saving valuable time and unnecessary frustration. After reading the last question on the exam, you will be allowed to revisit unanswered questions or marked questions. You can choose to go to the first of these in the group or to a specific question number.
8. **Do not run out of time.** Pay attention to the clock. Do not leave any question unanswered. Before you run out of time, select a choice for each question. Questions left unanswered will be counted against you. If you have to guess on a number of questions, improve your odds by selecting the same choice on each question. For example, select all As or all Cs but of course your goal is to manage your time and not have to guess on any of the questions.

The Dreaded Math

When it comes to the math portions of the exam, there are several very important and critical rules. It is in your best interest to convince yourself that for this one day, TEST DAY, you are going to take a methodical approach and deliberately follow each of the rules we are about to discuss.

1. **Always use a calculator.** This is probably the most critical and most important rule when it comes to math on the exam. Never perform mental calculations. Once you arrive at an answer, do the calculation again to check your answer. Repeat your calculations until you are certain the answer is correct.
2. **Use scratch paper to write down each step of math.** Professionals who use math on a daily basis, accountants, engineers, and the like, are sometimes the most difficult math students. Why? Because they refuse to write out the problem and their calculations, and they are reluctant to use a calculator for what they believe to be simple math. You do not want to fail this exam by one or two points; it hurts more to make a 69 than it does to make a 30. The point is, don't get in a hurry and miscalculate. Always write out your calculations and always calculate, at least twice, with a calculator.

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3. **Never round until you get to the end.** This simply means that you should never round any of your numbers until you solve the equation. When necessary, round based on the choices or the directions provided in the question.

4. **Draw it out.** If you have to sketch apples and stick people, do it. Remember, you do not want to fail this test by one question. It is critical that you use your scratch paper to draw as you solve the equation to answer the question.

5. **Always multiply like numbers.** In other words, do not mix feet and inches. If you multiply 10 feet by 8 feet 6 inches, the answer is not 86, it is 85. You cannot simply multiply 10 by 8.6—you must first convert the 6 inches to feet.

6. **When converting inches to feet, round to the nearest hundredth of a foot.** Yes, this is an exception to rules. You round to the nearest hundredth when converting inches to feet because it puts your answer in the correct range of the choices provided and allows you to write it down more easily. You would not want to write 0.3333333333333; it would be much simpler to write 0.33.

Try these rules as you delve into the next section of the book, which covers the basics for performing necessary math calculations found on most plumbing exams. Good luck.

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Alabama	(205) 945-4857	www.pgfb.state.al.us	Yes/PSI	Yes/Pre-approval	No
Alaska	(907) 465-3035	www.dced.state.ak.us/occ/pcon.htm	Yes/Prometric	No	Yes
Arizona	(602) 542-1525	www.rc.state.az.us/	Yes/Prometric	No	No
Arkansas	(501) 661-2642	www.state.ar.us/clb	Yes/Prometric	Yes/Pre-approval	No
California	(800) 321-2752	www.cslb.ca.gov	Yes/California State Licensing Board	Yes/Pre-approval	No
Colorado	(303) 894-2300	www.dora.state.co.us/	Yes/Promissor	Yes/Pre-approval	No
Connecticut	(860) 713-6135	www.state.ct.us/dcp	Yes/PSI	Yes/Pre-approval	Yes
Delaware	(302) 744-4504	www.dpr.delaware.gov	Yes/Prometric	Yes/Pre-approval	No
Florida	(850) 487-1395	www.state.fl.us	Yes/Professional Testing Inc.	No	Yes
Georgia	(478) 207-1416	www.sos.state.ga.us/plb/construct/	Yes/AMP	Yes/Pre-approval	Yes
Hawaii	(808) 586-2689	www.hawaii.gov/dcca/pvl	Yes/Prometric	Yes/Pre-approval	Yes
Idaho	(208) 334-3442	www2.state.id.us/	Yes/Plumbing Bureau	Yes/Pre-approval	Yes
Illinois	Not regulated by state/contact city/county		No		
Indiana	Not regulated by state/contact city/county		No		
Iowa	(515) 281-7995	www.iowaworkforce.org/	No/Register with state; city/county may require testing		
Kansas	Not regulated by state/contact city/county		No		
Kentucky	(502) 573-0364	www.ohbc.ky.gov	Yes/Plumbing Division	Yes/Pre-approval	No
Louisiana	(504) 826-2382	www.lslbc.state.la.us	Yes/State Plumbing Board	Yes/Pre-approval	No
Maine	(207) 624-8603	www.maineprofessionalreg.org	Yes/Prometric	Yes/Pre-approval	Yes
Maryland	(410) 230-6163	www.dllr.state.md.us	Yes/PSI	No	No
Massachusetts	(617) 727-9931	www.state.ma.us	Yes/PSI	Yes/Pre-approval	No
Michigan	(517) 241-9330	www.michigan.gov/dleg	Yes/State Plumbing Board	Yes/Pre-approval	No
Minnesota	(651) 284-5064	http://www.doli.state.mn.us/plumbing.html	Yes/State Plumbing Board	Yes	No
Mississippi	(601) 354-6161	www.msboc.state.ms.us	Yes/PSI	Yes/Pre-approval	No

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Missouri	Not regulated by state/ contact city/county		No		
Montana	(406) 841-2367	www.discoveringmontana.com/ dli/bsd/index.asp	Yes/State Plumbing Board	Yes/Pre-approval	Yes
Nebraska	No state licensing requirements at this time		No		
Nevada	(702) 486-1100	www.nscb.state.nv.us	Yes/PSI	Yes/Pre-approval	No
New Hampshire	(603) 271-3748	www.state.nh.us/plumbing/	Yes/International Code Council	No	No
New Jersey	(973) 504-6420	www.state.nj.us	Yes/State Plumbing Board	Yes/Pre-approval	Yes
New Mexico	(505) 452-8311	http://www.rld.state.nm.us/ CID/index.htm	Yes/PSI	Yes/Pre-approval	No
New York	Not regulated by state/ contact city/county		No		
North Carolina	(919) 875-3612	www.nclicensing.org	Yes/PSI	Yes/Pre-approval	No
North Dakota	(701) 328-9979	http://www.legis.nd. gov/information/rules/ admincode.html	Yes/State Plumbing Board	Yes/Pre-approval	No
Ohio	(614) 644-3493	www.com.state.oh.us/dic/ dicocilb.htm	Yes/International Code Council	Yes/Pre-approval	Yes
Oklahoma	(405) 271-5217	www.cib.sate.ok.us/	Yes/PSI	Yes/Pre-approval	Yes
Oregon	(503) 378-4133	www.oregonbcd.org	Yes/State Plumbing Board	Yes/Pre-approval	Yes
Pennsylvania	Not regulated by state/contact city/county		No/city/county may require testing		
Rhode Island	(401) 462-8000	www.dlt.state.ri.us	Yes/State Plumbing Board	Yes/Pre-approval	No
South Carolina	(803) 896-4686	www.llr.state.sc.us	Yes/PSI	No	No
South Dakota	(605) 773-3429	www.state.sd.us/dcr/ plumbing	Yes/State Plumbing Board	Yes/Pre-approval	No
Tennessee	(615) 741-8307	www.state.tn.us/commerce/ boards/contractors/	Yes/PSI	Yes/Pre-approval	No
Texas	(512) 458-2145	www.tsbpe.state.tx.us	Yes/State Plumbing Board	Yes/Pre-approval	Yes
Utah	(801) 530-6628	www.dopl.utah.gov	Yes/Prometric	Yes/Pre-approval	No
Virginia	(804) 367-8511	www.state.va.us/dpor	Yes/PSI	Yes/Pre-licensing	No
Washington	(360) 902-5207	www.lni.wa.gov	Yes/State Plumbing Board	Yes/Pre-approval	Yes
West Virginia	(304) 558-7890	www.labor.state.wv.us/	Yes/Prometric	No	No
Wisconsin	(608) 261-8500	www.commerce.wi.gov	Yes/State Licensing Board	Yes/Pre-approval	Yes
Wyoming	Not regulated by state/ contact city/county		No		

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PART ONE
Math

The following section covers the basic math concepts you are likely to encounter on your exam. It begins with a review of the terminology and simple concepts necessary to perform the calculations. Following the review, the 25 questions will test your general understanding of math as it applies to the plumbing industry.

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Study Tip

When two negative numbers are multiplied together the product becomes positive.

NUMBERS

Whole Numbers

Whole numbers are positive numbers without any fractions or decimals.

Examples: $100.00; 8 hours; 12 wrenches

When we speak or write whole numbers, we automatically calculate certain numbers in our minds. . .

625: Six hundred plus twenty plus five
625: When we speak, we leave out the plus.
Six hundred twenty-five

Mixed Numbers

Mixed numbers are whole numbers and parts of whole numbers. They can be expressed as fractions or as decimals.

Examples: $100.50; 7.5 hours; 5⅓ inches

Decimal Numbers

A decimal number refers to part of a whole number. It is based on 10 or tenths broken down into hundredths, thousandths, etc., depending on how many numbers follow the decimal point.

Examples: 1.5 inches; 7.75 feet; 6.25 pounds

Fractional Numbers

A fractional number refers to part of a whole number expressed in a fraction instead of decimal form. It is possible to convert decimals to fractions and fractions to decimals.

Examples: 2⅔ inches; 4½" pipe; 1¼ miles

$$\frac{a}{b} = \frac{\text{numerator}}{\text{denominator}} = \frac{\text{part of a whole number}}{\text{the whole number}}$$

Fraction Bar

The fraction bar is the slash between the numerator and the denominator. It means to divide.

Example: ¾ means 3 divided by 4 or 3 ÷ 4

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Labeling Numbers

Labeling numbers is very important. On construction sites an estimator makes the calculations and architects draft the construction drawings. Labels are important to identify the unit of measurement. Label all calculations or lengths as inches, feet, yards, lengths of pipe, volume, pounds, etc.

Steps required for solving the equation:

1. Examine the problem and decide what information is given and what calculations are required.
2. Write down the information given and what requires an answer.
3. Decide which type of mathematical calculation is required to solve the problem.
4. Execute the complete operation.
5. Label the answer with the appropriate unit: inches, feet, BTUs, etc.

MATHEMATICAL SYMBOLS

/ Fraction bar

+ Add

− Subtract

× Multiply

÷ Divide

= Equals

≠ Does not equal

√ Square root

π Pi = 3.14

( ) Perform the calculation in the parentheses first

PIPING CALCULATIONS

Plumbers will at sometime or another calculate piping offsets. Offsets are pipe assemblies connecting a section of pipe from one line to another. The pipes are usually parallel. When using the right triangle theory, the length of the sides of a pipe offset can be calculated knowing the angle of the fittings and the length of one of the sides.

Study Tip

Mathematics should be completed in this order: parenthesis, exponents, multiplication, division, addition then subtraction.

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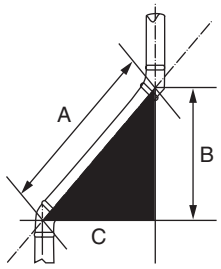
Study Tip

The hypotenuse is commonly known as the travel.



A. Hypotenuse = Travel
B. Altitude = Advance
C. Base = Offset

Three important lengths include:

A. Travel (Hypotenuse) which is the distance from the initial offset to the second fitting.

B. Advance (Altitude) is the distance parallel to the pipes between the offset fittings.

C. Offset (Base) is the distance the pipe is offset from its original position to the new position.

Some of the pipe fitting angles that are used by plumbers for pipe offsets are:

- 22½° elbow or 1/16 bend.
- 45° elbow or 1/8 bend.
- 60° elbow or 1/6 bend.
- 72° elbow or 1/5 bend.
- 90° elbow or 1/4 bend.

The plumber usually calculates the length of the travel. To calculate the travel, the angle of the fittings and the length of the advance or offset are required. The known values are multiplied by a constant. (See the single pipe offsets constants table below.) A 45° elbow (1/8 bend) is widely used by plumbers. The offset constant for this is 1.414 and should be memorized.

TABLE—SINGLE PIPE OFFSETS CONSTANTS

Fitting	Fitting Angle	Travel = Offset ×	Travel = Advance ×	Advance = Offset ×	Advance = Travel ×	Offset = Advance ×	Offset = Travel ×
1/32	11¼°	5.126	1.019	5.027	0.981	0.199	0.195
1/16	22½°	2.613	1.082	2.414	0.924	0.414	0.383
1/8	45°	1.414	1.414	1.000	0.707	1.000	0.707
1/6	60°	1.155	2.000	0.577	0.500	1.732	0.866
1/5	72°	1.051	3.236	0.325	0.309	3.078	0.951

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Calculating Travel—Travel = Offset × Constant or Travel = Advance × Constant

Example:

Calculate the travel of a 45° elbow (⅛ bend) with an offset of 29".

1. Place the known values.
   Travel = Offset × 1.414 (taken from offsets table on page 14)
   Travel = 29" × 1.414 (offset is given value)
2. Calculate the travel.
   29" × 1.414 = 41.006"
   Travel = 41.006 approximately 41"

Calculate End-To-End

41 inches is the distance of the travel from center-to-center (C–C) measurement. Subtract twice the end-to-center calculating the end-to-end (E–E) measurement. This will be the length of pipe you should cut. The rule of thumb is that you subtract twice the size of the pipe being cut to allow for the fitting on each end.

Example:

In the above calculation the C–C measurement was 41 inches. If the pipe offset was 2 inches the E–E measurement would be 37 inches.

41" − 4" (2" for both fittings) = 37"

Study Tip

Pythagorean theorem states that the square of the hypotenuse (side opposite of the 90° angle) of a right triangle is equal to the sum of the squares of the other two sides.

Multiple Pipe Offsets

Installing multiple pipes requires increased design ability by the plumber. Multiple pipes installed parallel to one another must be placed with a uniform spread. Spread is the center-to-center distance between the pipes. Offset elbows are installed evenly, guaranteeing an equal spread ensuring quality craftsmanship. 45° offsets are the best to use.

To install multiple pipes you must calculate the difference in the lengths of the pipes. The difference is added to or subtracted from the various pipe lengths used for the multiple pipe installation. Just like single pipe installations a constant value is used in the calculation.

MULTIPLE PIPE OFFSETS
Uniform Spread Constants
***S* = Spread *d* = difference pipe length**

Fitting	Fitting Angle	Difference in length $d = S \times$	Travel = Offset ×
1/32	11¼°	0.099	5.126
1/16	22½°	0.199	2.613
⅛	45°	0.414	1.414
¼	60°	0.577	1.155
⅕	72°	0.727	1.051

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Study Tip

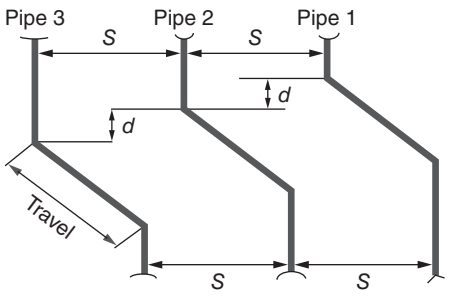
Trigonometric functions are used to compute pipe offsets because of the dimensions known. Two functions most likely used are the sine and the tangent.

Calculating Multiple Pipe Offsets

An equation is used to calculate multiple pipe offsets. Two of the three values are given and you calculate the third. To calculate multiple pipe offsets, use the following equation:

$$d = S \times \text{constant}$$

The *d* value or difference equals the difference in length of the pipes. The value is obtained from the table on page 15 and is based on the fitting size.



Multiple Pipe Offsets

To calculate a multiple offset using a uniform spread:

1. Calculate the spread (*S*).
2. Multiply *S* by the constant. The constant value is given in the table Multiple Pipe Offsets and is based on the fitting size.
3. Calculate the *d* value.
4. Measure each offset pipe *d* value longer than the pipe installed next to it.

Example:

Calculate two pipes 12 inches center-to-center (C–C). The offset is 26 inches with 45° elbows. Calculate the length differences and the C–C length of the travel pipes.

$$d = S \times \text{constant}$$

1. Enter known values in the equation. 12 inches is given and the constant value is located on the Multiple Pipe Offsets illustration above.

$$d = 12" \times 0.414$$

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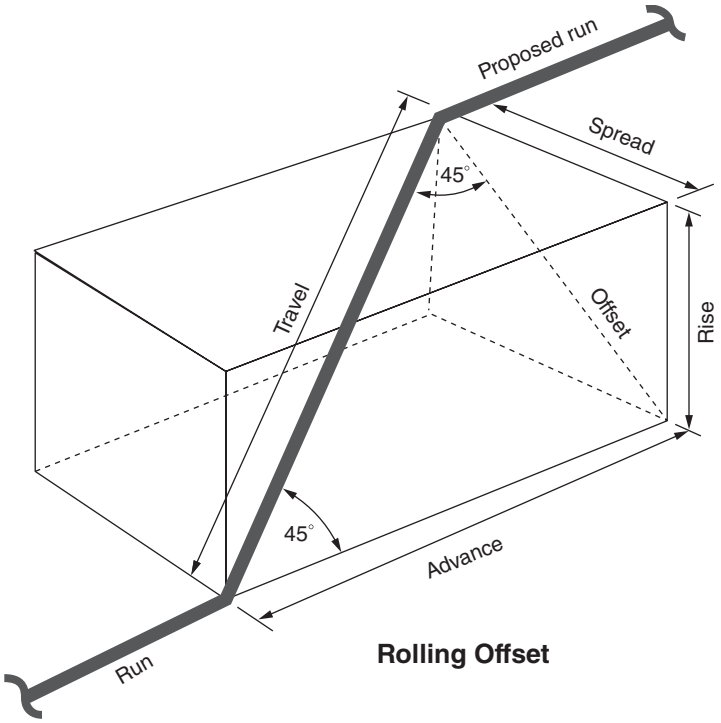
2. Calculate the *d* value. This is the difference in offset pipe lengths.

$d = 12" \times 0.414 = 4.968$
4.968 is approximately 5"

Note: Although pipe lengths change, travel remains the same for all pipes.

Rolling Offsets

Sometimes a pipe changes direction both horizontally and vertically. This is called a rolling offset. The illustration below displays a rolling offset with 45° fittings and a 60° elbow. Often a wye fitting is used instead of the 60° elbow.



Rolling Offset

Squared values and square roots are used to calculate the offset distance. Squared values are written as 5^2 or whatever the number is $\#^2$. To calculate a squared value, take the given number and multiply the given number by itself.

$2^2 = 4$ $3^2 = 9$ $4^2 = 16$ $5^2 = 25$

The offset is calculated by using the square root of the rise and spread. Rise is the actual vertical distance the pipe is offset and the spread is the horizontal distance the pipe is offset.

$$\text{Offset} = \sqrt{\text{rise}^2 + \text{spread}^2}$$

Study Tip

Rolling offset is the horizontal and vertical changes in direction of pipe.

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Study Tip

There are 144 square inches in one square foot.

ROLLING OFFSETS CONSTANTS		
Fitting	**Travel = Angle**	**Travel = Offset ×**
1/32	11¼°	5.126
1/16	22½°	2.613
1/8	45°	1.414
1/4	60°	1.155
1/5	72°	1.051

$$\text{offset} = \sqrt{\text{rise}^2 + \text{spread}^2}$$

The square root of a number *x* is shown by $\sqrt{x}$. When multiplied by itself the square root produces the value *x* under the square root symbol. Use a calculator to calculate square roots quickly.

The square root of 4 is 2. $2 = \sqrt{4}$
The square root of 9 is 3. $3 = \sqrt{9}$
The square root of 25 is 5. $5 = \sqrt{25}$

A plumber must know the constant, the length of the rise, and the spread value when calculating the travel of a rolling offset.

To calculate a rolling offset:

1. Square the rise.
2. Square the spread.
3. Add the values of step 1 and step 2.
4. Calculate the square root of step 3.
5. Calculate your travel.

Example:

Calculate the travel for a 45° rolling offset with a rise of 5 inches and a spread of 13 inches.

$$\text{Offset} = \sqrt{\text{rise}^2 + \text{spread}^2}$$

1. Enter the known values in the equation: 5 inches is the given rise and the given spread is 12 inches.

$$\text{Offset} = \sqrt{5^2 + 13^2}$$

2. Calculate the squared values of the rise and spread.

$$\text{Rise} = 5^2 = 25$$
$$\text{Spread} = 13^2 = 169$$

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3. Add the rise squared and the spread squared.

$$25 + 169 = 194$$

4. Calculate the square root of 194.

$$13.94 = \sqrt{194}$$

5. Place the known values to calculate the travel.

Travel = Offset × 1.414 (given in Rolling Offsets Constants table)
Travel = 13.94 (given in step 4) × 1.414

6. Calculate travel.

Travel = 13.94 × 1.414 = 19.71
Travel = 19.71" ≈ 19¾"

Common Rolling Offset

A common rolling offset used in plumbing is one that consists of a 45° wye and a 60° elbow. This is a very convenient set of values for a plumber. When these figures are used to implement a rolling offset, the rise and spread lengths are equal and the travel equals two times that length. For this exact situation, you can calculate the travel by multiplying the rise or the spread by 2.

Situation = Rolling offset with a 45° wye and a 60° elbow
Travel = Rise × 2 = Spread × 2

Pitch and Grade

Pitch and grade are used interchangeably. Drainage piping is set at a certain pitch (grade) to ensure adequate drainage. Pitch (*P*) is the slope of a line in respect to the horizontal plane. Pitch is displayed in inches per foot.

In the pipe's given length, fall (*F*) is quantity the line drops. Fall (drop) is expressed in inches.

Study Tip

Common rolling offset consists of a 45° wye and a 60° elbow.

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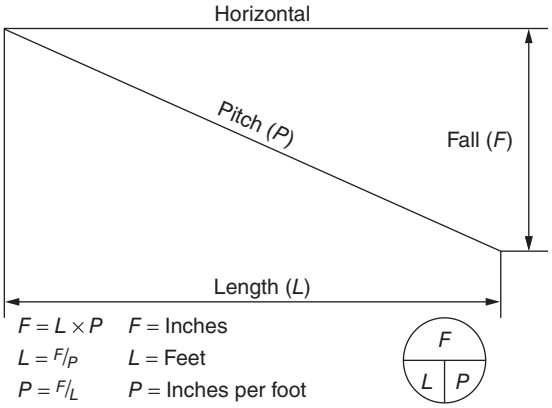
Study Tip

Pitch is the degree of slope or grade given a horizontal run of pipe.

Pipe length (*L*) is the length of the pipe displayed in feet.

Several equations are possible when dealing with pitch.

Fall = Length × Pitch Pitch = Fall ÷ Length
Length = Fall ÷ Pitch Pitch = Length × % grade



Examples:

Calculate the fall of a pipe run 32 feet long with a pitch at ¼" per feet.

Fall = Length × Pitch

1. Enter known values in the equation.

   Fall = 32' × ¼"

2. Calculate the value.

   Fall = 32/1 × ¼ = 32/4

3. Simplify the value.

   Fall = 32/4 = 8"

Calculate the length of a pipe with a pitch at ⅛ inch/foot and a fall of 40 inches.

Length = Fall ÷ Pitch

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1. Enter the known values in the equation.

   Length = 40" ÷ 1/8

2. Calculate the value.

   Length = 40" × 8/1 = 320/1

3. Simplify the value.

   Length = 320/1 = 320'

Calculate the pitch of a pipe that is 160 feet long and falls at 16".

Pitch = Fall ÷ Length

1. Enter known values in the equation.

   Pitch = 16" ÷ 160'

2. Calculate the value.

   16/160 = 1/10 inch/foot

Converting Percentage Grade to Fractional Inches per Foot

When converting a percentage grade to the equivalent fractional grade in inches per foot, divide the percentage grade by 100. This value is multiplied by 12 to calculate the decimal figure.

Pitch = (% grade ÷ 100) × 12

Example:

Calculate the fractional pitch for a 3% grade.

1. Enter the known values in the equation.

   Pitch = (3% ÷ 100) × 12
   Pitch = (3 ÷ 100) × 12

2. Calculate the value.

   Pitch = (3/100) × 12
   Pitch = (0.03) × 12

Study Tip

Fall is the amount of slope given to a horizontal run of pipe.

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Study Tip

A cubic foot of water equals 1728 cubic inches.

Pitch = 0.03 × 12 = 0.36
Pitch = 0.36 ≈ ⅓ inch/foot
3% grade = ⅓ inch/foot

Converting Pitch in Inches per Foot to Percentage Grade

When converting a fractional grade in inches per foot to the equivalent percentage grade, convert the fractional pitch into a decimal and then divide by 12.

Example 1:

Calculate the percentage grade for the fractional pitch of ½" per foot.

1. Convert fraction into a decimal **½ = 1 ÷ 2 = 0.5**
2. Divide by 12 **0.5 ÷ 12 = 0.04**

Percentage grade = **0.04 or 4%**

Example 2:

Calculate the percentage grade for the fractional pitch of ¼" per foot.

1. Convert the fraction to a decimal **¼" = 1 ÷ 4 = 0.25**
2. Divide by 12 **0.25 ÷ 12 = 0.02**

Percentage Grade = **0.02 or 2%**

WATER CALCULATIONS

Water is present in three types of known states:

- Solid – Ice
- Liquid – Water
- Gas – Steam

When heat is added or taken away, a solid, liquid, or gas can change form. For instance, when heat is added to water, it will boil at 212°F changing the liquid to steam. When heat is taken away from water, it will freeze and become a solid at 32°F. Water, when frozen, expands to 8.33% of its normal volume, and it is the only substance on this planet where the maximum density of its mass does not occur when it becomes solidified.

For example, if a cubic foot of water (1728 cubic inches) freezes, you now have 1872 cubic inches of ice.

1728 + 8.33% = 1872 cubic inches

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Calculating Water Pressure

Pressure is used to force water into and through buildings. Water pressure equals 0.434 pounds per square inch (psi) at the base of any container. Pressure gauges indicate the psi in the pipe to which it is connected. Most pressure gauges correct for the atmospheric pressure and are marked as pounds per square inch (psi). A head is a column of water. A 1-foot head equals a container with 1 foot of water. A 3-foot head contains three feet of water, and so on. Pipe is considered a container. For every 1-foot vertical increment, 0.434 psi is exerted. Diameter is not a factor. Pressure is directly related to the length of the pipe.

2.3 feet of head equals 1 psi of water
$2.3' = 1 \div 0.434$

Given this calculation, for every foot of pipe, 0.434 psi is lost in pressure. This is a 1 psi loss for every 2.3 feet in height. To calculate the correct pressure or head for a building, you require the known head or the known pressure.

Pressure = Head × 0.434
Head = Pressure × 2.3

Study Tip

Psi is defined as pounds per square inch.

PRESSURE AND HEAD			
Head in Feet	**Pressure (psi) Pounds per Square Inch**	**Head in Feet**	**Pressure (psi) Pounds per Square Inch**
2.304	1	1	0.434
4.608	2	2	0.868
6.912	3	3	1.302
9.216	4	4	1.736
11.520	5	5	2.170
13.824	6	6	2.604
16.128	7	7	3.038
18.432	8	8	3.472
20.736	9	9	3.906
23.040	10	10	4.340
PSI and Heads	Pressure = Head × 0.434	Head = Pressure × 2.3	Water = 62.5 pound per cubic foot

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Study Tip

Pressure head is measured by the depth of a column of water, above the point where the measurement is taken.

Example:

Calculate the pressure created by a head 72 feet 6 inches.

Pressure = Head × 0.434

1. Enter the known values in the equation.

   Pressure = 72' 6" × 0.434
   Pressure = 72.5' × 0.434

2. Calculate the value.

   Pressure = 72.5' × 0.434 = 31.465
   Pressure ≈ 31½ psi

Example:

Calculate the head equivalency to a pressure of 60 psi.

Head = Pressure × 2.3

1. Enter the known values in the equation.

   Head = 60 psi × 2.3

2. Calculate the value.

   Head = 60 psi × 2.3 = 138 feet
   Head = 138 feet

Volume of a Pipe or Cylindrical Container

The volume of a pipe or cylindrical container can be calculated by multiplying $\pi \times r^2 \times$ h (3.14 × radius squared × height)

Example:

Calculate the volume of pipe 14 feet long with a radius of 2 inches.

Volume = $\pi \times r^2 \times h$

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1. Enter the known values in the equation.

   Volume $= 3.14 \times 2^2 \times 168$ inches (14' converted to inches)

2. Calculate the value.

   Volume $= 3.14 \times 4 \times 168$
   Volume $= 2110.08$ cubic inches

Volume of a Pipe in Gallons

The volume, in gallons, for any length of pipe is calculated by multiplying 0.0408 by the inside diameter squared (D^2) by the length (L) in feet.

$$\textbf{Volume} = 0.0408 \times D^2 \times L$$

Example:

Calculate the volume, in gallons, for a pipe 10 feet long with a diameter of 6 inches.

1. Enter the known values in the equation.

   Volume (gal.) $= 0.0408 \times 6^2 \times 10'$

2. Calculate the value.

   Volume $= 0.0408 \times 36 \times 10'$

   Volume $= 14.688$ gallons

Note: This formula works because a cylinder 1 inch in diameter and 1 foot long holds 0.0408 gallons.

Weight of Water in a Pipe

When calculating the weight of water in a pipe, multiply 0.34 by the diameter squared (D^2) by the length (L) in feet of the pipe.

$$\textbf{Weight} = 0.34 \times D^2 \times L$$

Example:

Calculate the weight of water in a 6 inch pipe that is 8 feet long.

Study Tip

A gallon of water is equal to 8.33 pounds.

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Study Tip

There are 231 inches of cubic water in 1 gallon.

1. Enter the known values in the equation.

$$\text{Weight} = 0.34 \times 6^2 \times 8'$$

2. Calculate the value.

$$\text{Weight} = 0.34 \times 36 \times 8'$$
$$\text{Weight} = 97.92 \text{ pounds}$$

Converting Cubic Inches to Gallons of Water

231 cubic inches of water equals 1 gallon of water. To calculate gallons divide the volume of water by 231.

Volume = Cubic Inches ÷ 231

Example:

Convert the volume of a container with 5775 cubic inches.

1. Enter the known values in the equation.

$$\text{Volume} = 5775 \div 231$$

2. Calculate the value.

$$\text{Volume} = 5775 \div 231 = 25 \text{ gallons}$$

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DETERMINING MARKUP

If a plumber purchases a water closet tank repair part for $15.00 and sells it to the customer with a 30½% markup, how much will the customer be charged?

1. Enter the known values in the equation.

   30½% = 30.5%

2. Convert the percentage to a decimal. Do this by moving the decimal point to the left two places.

   30.5% = 0.305

3. Multiply the cost of the repair part by 0.305

   $15 × 0.305 = $4.575 or $4.58

4. Add the markup price to the original cost.

   $15.00 Cost
   +4.58 Markup
   $19.58 Selling Price

Note: Insert the markup you desire in place of the 30½%

Study Tip

Markup determines the amount of profit to be made.

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Notes

Percentage, Base, and Rate

You may be required to calculate a specific percentage (*P*), base (*B*), or rate (*R*).

$$\boldsymbol{P = B \times R}$$
$$\boldsymbol{B = P \div R}$$
$$\boldsymbol{R = P \div B}$$

Example:

Figure the payment percentage due on a job. Initially, a $200 down-payment was made. The contract asks for $600 total.

1. Enter the known values in the equation.

$$P = B \times R$$
$$\$200 = \$600 \times R$$

2. Divide both sides by 600.

$$^{200}\!/_{600} = 1 \times R$$

3. Reduce the fraction.

$$⅓ = R$$

4. Convert the fraction to a percentage.

$⅓ = 0.33$
33% was paid up-front
67% is left to be paid

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PART TWO
Math Practice Exam

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Study Tip

Laying length is the amount the pipe must be shortened to make the assembly of pipe and fittings equal to the theoretical length.

PRACTICE EXAM

1. What is an offset?
   a. The vertical distance between two pipes
   b. Pipe assemblies connecting a section of pipe from one line to another
   c. The length of pipe less the fittings
   d. All the above

2. Calculate the travel of a 45° offset with an offset of 28 inches.
   a. 39½"
   b. 33½"
   c. 11⅜"
   d. 37¼"

3. Calculate the travel of a 45° rolling offset with a rise of 8 inches and a spread of 20 inches.
   a. 30"
   b. 29¾"
   c. 30½"
   d. 33¼"

4. Calculate the fall of a drainage pipe 110 feet at a 4% grade.
   a. 4.4'
   b. 5'
   c. 4'
   d. 4.875'

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5. Calculate the pressure created by a head 50 feet 9 inches.

   a. 20.23 psi

   b. 21 psi

   c. 24 psi

   d. 22.03 psi

6. What is the volume of a pipe 14 feet long with a diameter of 6 inches?

   a. 21.7836 gallons

   b. 20.5632 gallons

   c. 14.3268 gallons

   d. 19.8887 gallons

7. A customer wanted 40 psi at a building with only 20 psi available. The plumber was told to install a water tower. How much head would he need to have the 40 psi?

   a. 40'

   b. 17.36'

   c. 92'

   d. 86.5'

8. Fractional numbers _____.

   a. are part of the whole number

   b. are expressed in decimal form

   c. can be converted to decimals

   d. Both a and c

9. Which of the following is not considered when installing multiple pipe offsets?

   a. Spread

   b. Difference in pipe lengths

   c. Travel

   d. None of the above

Study Tip

PSF is pressure per square foot.

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Study Tip

Elevation of a water tower influences water pressure.

10. Whole numbers are _____.

    a. whole numbers and fractions

    b. positive numbers without fractions or decimals

    c. positive numbers with fractions and decimals

    d. numbers with decimals

11. Water, when frozen, expands _____ of its normal volume.

    a. 7.5%

    b. 8.33%

    c. 9.25%

    d. 9.76%

12. You are to install a new sewer line from building to sewer main. The sewer at the building is 3 feet deep. The ground surface is level. The distance from building to sewer main is 75 feet. How much deeper (fall) will the pipe need to be at the main sewer if the pitch (slope) is ⅛ inches per foot?

    a. 9⅜"

    b. 19½"

    c. 12¼"

    d. 14½"

    e. None of the above

13. The pressure at street level is 60 psi. You must run a water service to a house built on a 30 foot rise. What is going to be the pressure at the house?

    a. 60 psi

    b. 13.8 psi

    c. 34 psi

    d. None of the above

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14. What is the one constant to memorize when calculating pipe offsets?

    a. 0.0408

    b. 1.414

    c. 2.3

    d. 0.434

15. When calculating pipe offsets, what must be given?

    a. Constant

    b. Offset (base)

    c. Advance (altitude)

    d. Either b or c

    e. All of the above

16. Calculate the weight of water in a 10-inch pipe that is 10 feet long.

    a. 340 lbs.

    b. 34 lbs.

    c. 340 psi

    d. 34 psi

17. Calculate volume of a tank (pipe) 20 feet in height with a diameter of 48 inches.

    a. 36,191.232 cu. in.

    b. 31,619.623 cu. in.

    c. 24,915.167 cu. in.

    d. 434,294.78 cu. in.

Study Tip

Hypotenuse is calculated as a constant of 1.414.

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Study Tip

Volume equals $\pi r^2 h$.

18. How many gallons does the tank in question 17 hold?

    a. 1500 gal.

    b. 1880 gal.

    c. 2127 gal.

    d. 2475 gal.

19. Calculate a 1½ inch pipe offset that has an advance of 48 inches.

    a. 67⅞"

    b. 72⅞"

    c. 64⅞"

    d. 67⅞"

20. You buy a pressure reducing valve (PRV) for $35.98 to install for a customer. You want to make a 33⅓% markup. What would you charge the customer?

    a. $47.96

    b. $35.98

    c. $48.00

    d. $62.36

21. Why are labels on pipe, valves, etc., important?

    a. Labels identify hazards

    b. Labels identify contents

    c. Labels identify units of measurements

    d. All of the above

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22. Your estimate totals $4,450.00 to replace a 4-inch sewer line. You want 60% down and 40% balance upon completion of job. How much do you need to collect before you start the job?

    a. $2,225.00

    b. $2,670.00

    c. $1,780.00

    d. None of the above

23. You estimated a job for $2,195.00. You agree to $900.00 up front with the balance paid when job is completed. What is the percentage you will collect up front?

    a. 33⅓%

    b. 45%

    c. 41%

    d. 38½%

24. What is the balance due at the completion of the job from question 23?

    a. $1,295.00

    b. $900.00

    c. Neither a nor b

    d. Both a and b

25. What does a *fraction bar* mean?

    a. Multiply

    b. Add

    c. Subtract

    d. Divide

Study Tip

Labor costs, material costs, and rental equipment are a few examples of what is included in an estimate.

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PART THREE
Pipe, Fittings, and Symbols

This section serves as a review of pipe, fittings, and symbols used throughout most plumbing exams. A review of this section will prove beneficial in understanding the code, math, general knowledge, and identification practice exams that follow.

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Study Tip

A drain is sized according to the drainage fixture load value assigned to each fixture.

PIPES

Drainage Pipe

Drainage pipes encountered by plumbers might be cast iron, steel, galvanized, DWV copper, schedule 40 PVC DWV plastic, clay, cement, or lead. The most common pipe used today is schedule 40 PVC because it is easy to work with and it is economical.

Cast Iron: Comes in single hub 5' and 10' and 5' double hubbed. Also comes in standard and extra-heavy weights. Color is black.

Steel: Usually comes in 20- or 21-foot lengths. Color is black.

Galvanized Steel: Usually comes in 21-foot lengths. Color is black.

DWV Copper: Usually comes in 20-foot lengths. Very expensive. Color is copper with a yellow stripe lengthwise.

PVC Schedule 40 DWV: Comes in various lengths. Color is white.

Plastic: A lightweight pipe used for leach field lines. Comes with or without holes for drainage. Comes in different colors, mostly white.

Clay: Used mostly in main sewer and storm drainage systems.

Cement: Used mostly in storm drainage systems.

Note: Lead pipe is now prohibited because of the potential hazard of lead poisoning.

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Water Distribution Pipe

Water distribution pipes that you will encounter might be galvanized steel, copper types K, L, and M, schedule 40 PVC, CPVC, PE (polyethylene), PB (polybutylene), and PEX.

Copper Type K: Heaviest gauge used in commercial, industrial, and for underground water service lines. Color code is green.

Copper Type L: Most used of the copper types. Can be used for hot- or cold-water lines. Comes in various sizes ¼" to 4", also various lengths 2' to 20'. Color code is blue.

Copper Type M: Used for inside building and in walls. Not to be used in the ground, very thin. Comes in various sizes ½" to 2", and various lengths 5' to 20'. Color code is red.

PVC Schedule 40: Used for cold-water distribution only. Can be used for water service lines. Comes in various sizes ½" to 4", and comes in various lengths 5' to 20'. Color is white.

CPVC: Used for hot- and cold-water distribution. Comes in various sizes ½" to 2", and various lengths 5' to 20'. Color is cream.

PE (Polyethylene): Usually sold in coils. Used for water supply systems, jet wells, farm sprinkler systems, chemical well lines, and gas gathering systems. Joined together with plastic insert fittings and clamps. Sold in sizes ¾", 1", 1½", and 2". Color is black.

PB (Polybutylene): Flexible tubing (old style was gray—new style is milky white). Comes in 20-foot lengths and 50- to 1000-foot coils. Used for residential water supply only, mostly in mobile homes.

PEX: One of the most versatile, easy-to-use plumbing systems available. Can be used for hot- or cold-water systems. Uses brass fittings and copper crimp rings. A manifold can be used which has a shut-off valve for each line. Color usually is white. Can be color red for hot and color blue for cold.

Note: Be sure and check local codes. Some types of pipe may be prohibited in your area.

Study Tip

The longer the pipe, the more the pressure will drop since there is more friction to overcome.

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Study Tip

Tees are fittings that create 90° branches in the piping.

FITTINGS

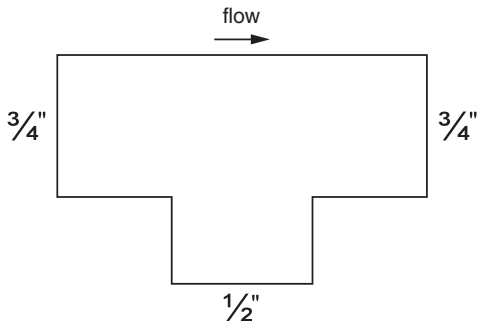
Elbows: Should be read as follows:

1/16 bend or 22½° bend
⅛ bend or 45° bend
¼ bend or 90° bend
⅙ bend or 60° bend
⅕ bend or 72° bend

Tees and Wyes: Should be read by reading the flow first and then the side inlet. If it is a reducing fitting, the largest flow side should be read first.

Example:

A tee that has a flow of ¾" and a side inlet of ½" would be read: ¾ × ¾ × ½ tee, but when the flow sizes are the same, you read it: ¾ × ½ tee. The second ¾ is understood.



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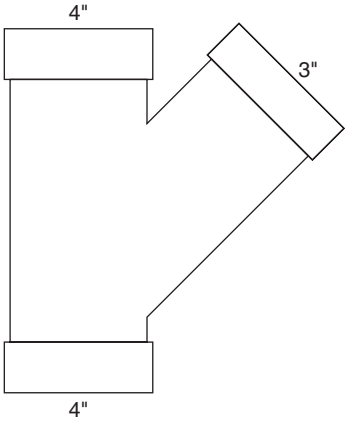
Example:

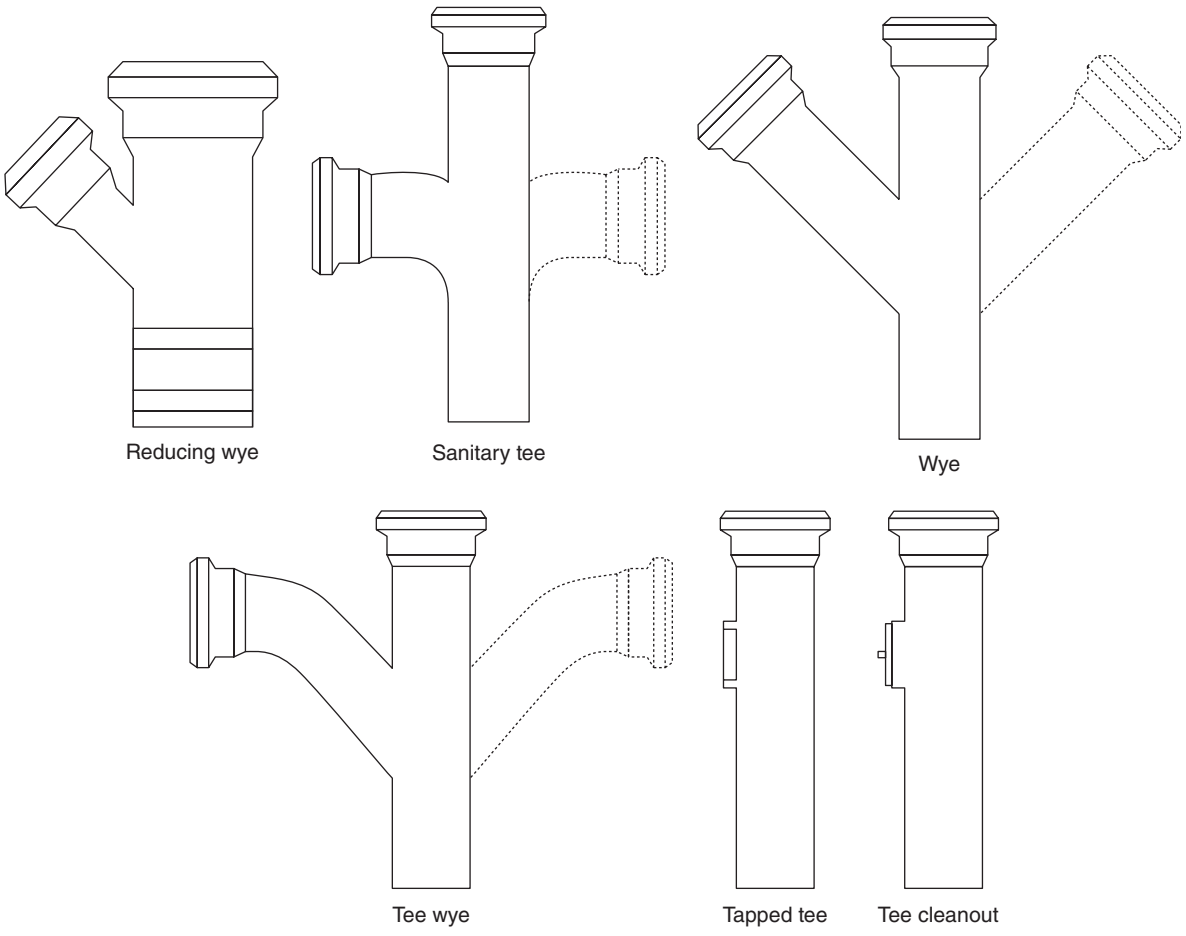
The same rules apply to reading drainage fittings:



Read: 4 × 3 reducing wye

Drainage Fittings

Cast-iron fittings



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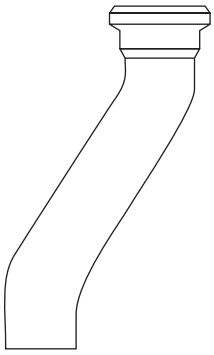
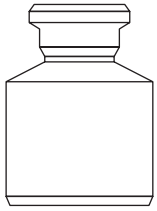
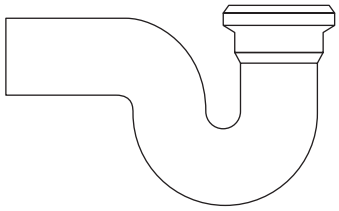


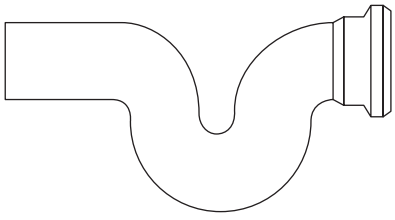
Offset



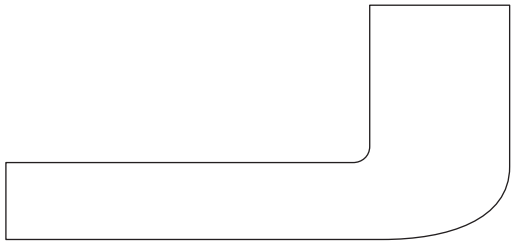
Reducer



P-trap

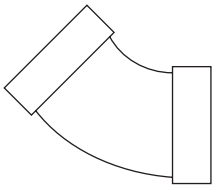


Running trap

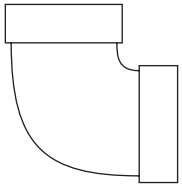


Closet bend

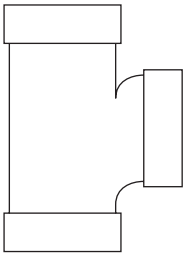
PVC Schedule 40 DWV Fittings



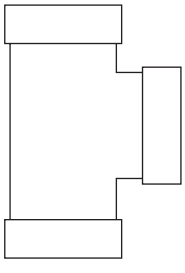
45° elbow



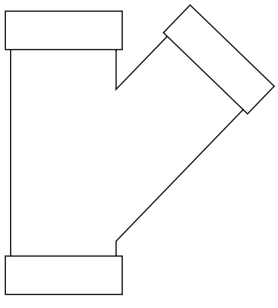
90° elbow



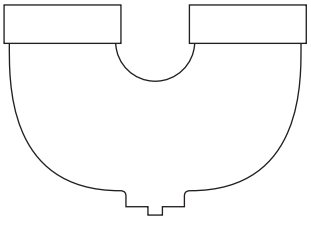
Tee



Vent tee



Wye



Trap

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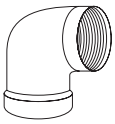
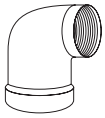
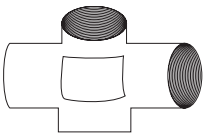
WATER DISTRIBUTION FITTINGS

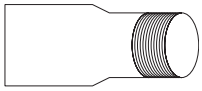
Galvanized Fittings


45° elbow

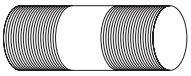

90° elbow

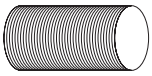

90° Reducing elbow

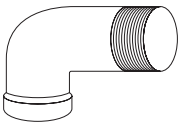

Cross

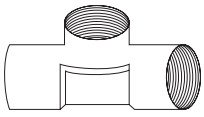

Extension coupling

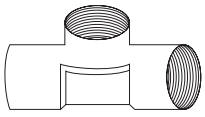

Long nipple


Short nipple

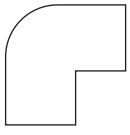

Close nipple

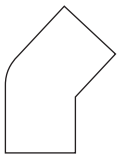

Streel elbow


Straight tee


Reducing tee

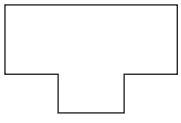
Copper Fittings


90° elbow

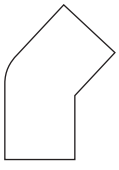

45° elbow

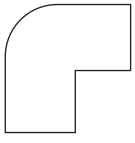

Cap

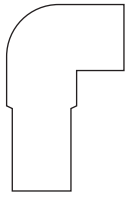

Coupling


Tee

CPVC Fittings

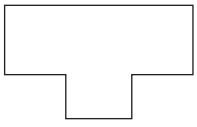

45° elbow

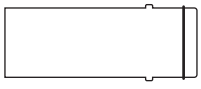

90° elbow


90° street elbow


Coupling


Strap


Tee


Transition fitting


Cap

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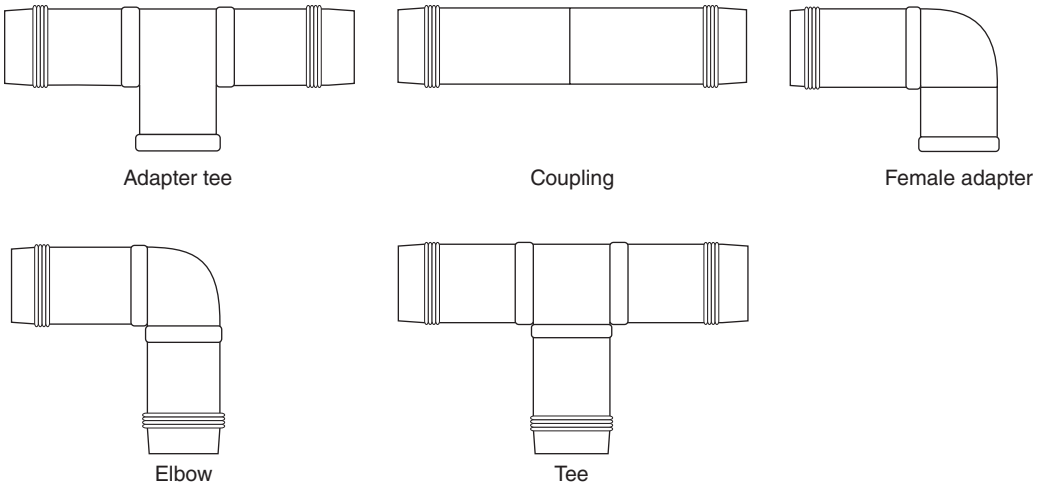
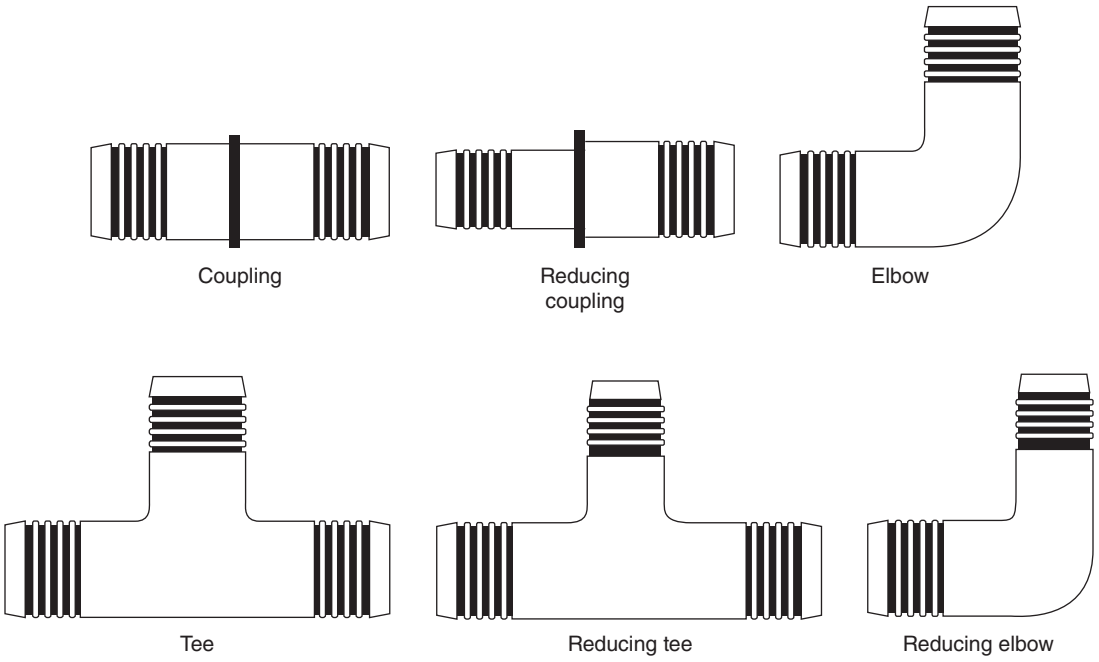
PE (Polyethylene) Fittings



PB (Polybutylene) Fittings



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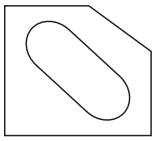
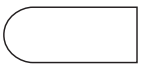
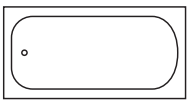
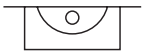
PLUMBING/BLUEPRINT SYMBOLS

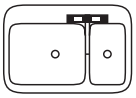

Corner bathtub

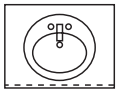

Freestanding bathtub

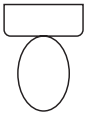

Recessed bathtub

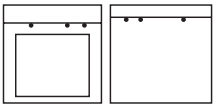
Bidet


Drinking fountain wall mount

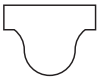

Kitchen sink


Vanity

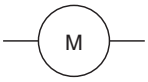

Water closet


Washer/dryer


Shower stall


Urinal

Water heater

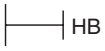


Water meter

Floor drain

Roof drain


Valve



Hose bibb

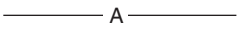
Cold-water supply

Hot-water supply

Hot-water return

Soil or waste line

Vent line

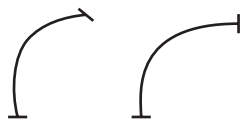


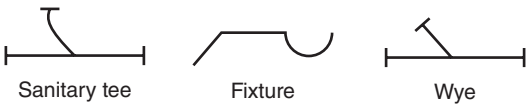
Air line

Fuel gas line

Vacuum line

Fire protection





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Study Tip

PVC is used for cold-water piping and CPVC is used for hot-water piping.

PIPE, FITTINGS, AND SYMBOLS PRACTICE EXAM

1. Which elbow(s) are read correctly?

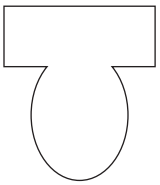
   a. ¼ bend or 90° bend

   b. ⅛ bend or 45° bend

   c. 1/16 bend or 22½° bend

   d. All of the above

2. Identify this blueprint symbol.



   a. Vanity

   b. Water closet

   c. Bidet

   d. Toilet

3. Where can you use PVC Schedule 40 water pipe?

   a. All water distribution systems

   b. Cold-water distribution systems

   c. Hot-water distribution systems

   d. Hot-water heating systems

4. Where can you use CPVC water pipe and fittings?

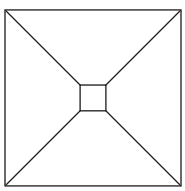
   a. Liquid propane distribution systems

   b. Cold-water distribution systems

   c. Hot-water distribution systems

   d. Both b and c

5. Identify this blueprint symbol.



   a. Shower stall

   b. Washer

   c. Dryer

   d. Laundry sink

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6. Identify this plumbing symbol. 

   a. Tee
   b. Wye
   c. Valve
   d. Cross

7. Some of the pipes used for water distribution are

   a. CPVC
   b. Copper
   c. PEX
   d. PVC DWV
   e. a, b, and c

8. Drainage pipe/s you might encounter is/are

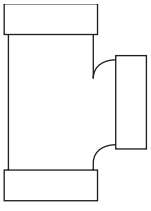
   a. CPVC
   b. PEX
   c. PE
   d. None of the above

9. What does this blueprint symbol represent?

   a. Air line
   b. Cold-water line
   c. Hot-water line
   d. Fire-protection line

10. Identify this fitting.

    a. Cleanout tee
    b. Sanitary tee
    c. Vent tee
    d. None of the above



Study Tip

Sanitary tees have a curve at the inlet to facilitate flow and prevent blockage.

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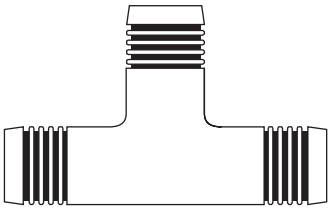
Study Tip

To keep drawings to relatively small sizes, fractions are used to represent feet. This is known as scale drawing.

11. This fitting is used with what kind of pipe?

    a. PB (polybutylene)
    b. CPVC
    c. PVC
    d. Copper



12. What does this blueprint symbol represent? —·—·—·—·—

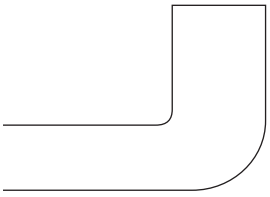
    a. Cold-water line
    b. Hot-water return line
    c. Hot-water line
    d. Air line

13. What does this blueprint symbol represent? ___ FG ___ FG ___

    a. Fuel gas line
    b. Fuel gathering line
    c. Fire prevention line
    d. Drainage pipe line

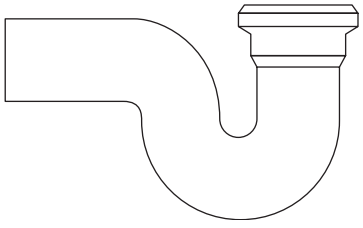
14. Identify this fitting.

    a. Long turn elbow
    b. 90° bend
    c. Closet bend
    d. ¼ bend



15. Identify this fitting.

    a. P-trap
    b. Running trap
    c. S-trap
    d. Drum trap



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