Water Treatment Math

Course Overview

This course is designed to acquaint students with the math, formulas and calculations used in water treatment, storage, and distribution. Course material consists of reading assignments, video lectures, review questions, study problems and lesson quizzes.

Course completion requires that the student successfully complete each component of each individual lesson. Review questions and written assignments must be submitted either online or uploaded in a Word document for the professor's review. Lesson quizzes have a minimum passing score of 70%.

Upon successful completion of the course requirements, students will receive a certificate of completion for 3.6 CEUs (36 contact hours) for the *Water Treatment Math* course, which is applicable toward a Certificate in Water Treatment Technology from American Water College.

Water Treatment Math (3.6 CEUs)

- Powers and Scientific Notation
- Dimensional Analysis
- Rounding and Estimating
- Solving for the Unknown Value
- Ratios and Proportions
- Averages
- Percentages
- Linear Measurements
- Area Measurements
- Volume Measurements

Required Texts

Textbook: *Basic Science Concepts and Applications,* Principles and Practices of Water Supply Operations series
Edition: Fourth Edition
Author: Nicholas G. Pizzi
ISBN: 1-58321- 778-9

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Educational Objectives

- To provide a foundational understanding of powers and scientific notation
- To demonstrate dimensional analysis
- To provide students with an understanding of rounding, estimating, and solving for an unknown value
- To demonstrate ratios, proportions, averages, and percentages
- To provide students with an understand of linear measurements
- To provide a foundational understanding of area and volume measurement calculations
- To demonstrate conversions
- To demonstrate graphs and tables and their uses in water treatment
- To provide students with a foundational understanding of calculating per capita water use, domestic water use, and industrial water use
- To demonstrate calculating average daily flow, surface overflow and weir overflow rates
- To provide a foundational understanding of filter loading and filter backwash rates
- To demonstrate mudball calculation
- To demonstrate detention time calculations
- To demonstrate well problem calculations

Evaluation

Students will be graded on their performance on each lesson quiz, and their course participation. Unless each unit is completed, the student will not be permitted to advance to the next lesson, and the student will not be awarded credit for completion until all assignments, quizzes and lectures are completed. Please contact our office with any questions.

Support

Students can contact our student support staff with any course-related, content-related, or technology-related inquiries. Our office hours are Monday-Thursday, 9-5 CT, and Friday 9-12 CT.

Contact Info:

Phone Number: (661) 874-1655
Email Inquiries: Info@americanwatercollege.org

Additionally, students are encouraged to contact their professor directly with any questions or comments.

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Lesson 1 – Powers and Scientific Notation

Summary of This Lesson

In this lesson we will be covering two common methods of expressing numbers: powers and scientific notation.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to convert numbers and units from exponential form to whole numbers or expanded form
- How to change numbers and units from the expanded form into the exponential form
- How to take numbers out of positive and negative scientific notation
- How to put numbers in scientific notation

Assignments for This Lesson

- Read Mathematics Chapter 1, "Powers and Scientific Notation," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 1
- Complete the quiz for Lesson 1

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Lesson 2 – Dimensional Analysis

Summary of This Lesson

Dimensional Analysis is a tool to determine whether you have setup a problem correctly. Dimensional analysis does not use any numbers, it only uses the units to check the math problem.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to express a horizontal fraction as a vertical fraction
- How to divide a fraction
- How to divide out or cancel terms in the numerator and denominator of a fraction

Assignments for This Lesson

- Read Mathematics Chapter 2, "Dimensional Analysis," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 2
- Complete the quiz for Lesson 2

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Lesson 3 – Rounding and Estimating

Summary of This Lesson

Estimating will help you have a ballpark idea of what your end answer should be. It gets you close to the final answer quickly. To estimate you will also be rounding. Rounding is done by replacing the final digits of a number with zeros.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to round a complex number to a place value in the decimal system
- How to estimate the approximate value of a calculation

Assignments for This Lesson

- Read Mathematics Chapter 3, "Rounding and Estimating," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 3
- Complete the quiz for Lesson 3

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Lesson 4 – Solving for the Unknown Value

Summary of This Lesson

Often, you will be given a formula and all but one piece of information. Using the formula, you can solve for that last bit of information. At times though, you will have to change the formula using addition, subtraction, multiplication, and division.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to solve for the unknown value in formulas using multiplication and division
- How to solve for the unknown value in formulas using addition and subtraction

Assignments for This Lesson

- Read Mathematics Chapter 4, "Solving for the Unknown Value," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 4
- Complete the quiz for Lesson 4

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Lesson 5 – Ratios and Proportions

Summary of This Lesson

Ratios are a common expression of how two numbers relate to each other. When ratios are proportionate, it means the numbers have been scaled up equally. We will cover what ratios and proportions are as well as how to calculate and use them.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How ratios and proportions and used
- The applications of ratios and proportions in water system calculations
- How to perform ratio and proportion calculations

Assignments for This Lesson

- Read Mathematics Chapter 5, "Ratios and Proportions," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 5
- Complete the quiz for Lesson 5

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Lesson 6 – Averages

Summary of This Lesson

An average is simply taking a larger amount of data and finding one number to represent it. We will cover, how to calculate averages and what their used for.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate averages of groups of numbers
- Common applications of averaging in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 6, "Averages," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 6
- Complete the quiz for Lesson 6

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Lesson 7 – Percent

Summary of This Lesson

Percent is an expression per 100. Percentages are the way you can take any number, whether higher or lower than 100, and express it as a part of the whole. They can be converted to decimal numbers and fractions. Most percentages are used in formulas as decimals instead of percentages.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to perform percent calculations
- Common uses of percent calculations in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 7, "Powers and Scientific Notation," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 7
- Complete the quiz for Lesson 7

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Lesson 8 – Linear Measurements

Summary of This Lesson

Linear measurements are a measure of distance. It is expressed as a straight line even if it comes from curved or angular objects. For example, a circumference is a linear measurement around a circle. When you write the circumference, you write it as a line in feet or yards or meters.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of performing linear measurements of angular and circular objects
- Common applications of linear measurements in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 8, "Linear Measurements," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 8
- Complete the quiz for Lesson 8

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Lesson 9 – Area Measurements

Summary of This Lesson

Area measurements are measures of object surfaces. Commonly you will see square feet and square inches, but there are many other area measures you can use; such as, square yards, square meters, square centimeters and so on. Acre is also a unit of area. In this lesson though, we will be focusing on the three most commonly used area calculations of square, circle, and triangle.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate area measurements of rectangles, triangles, and circles
- Common applications of area measurements in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 9, "Area Measurements," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 9
- Complete the quiz for Lesson 9

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Lesson 10 – Volume Measurements

Summary of This Lesson

In lesson 8 we covered linear measurement. In lesson 9 we covered area measurements. Now we will add a 3rd dimension to cover volume measurements. Volume is the amount of space an object occupies. It will always be expressed as a cube, even for volumes with square or jagged edges.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate volume measurements of shapes such as boxes, cylinders, cones, and shapes
- Common applications of volume measurements in water systems

Assignments for This Lesson

- Read Mathematics Chapter 10, "Volume Measurements," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 10
- Complete the quiz for Lesson 10

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Lesson 11 – Conversions

Summary of This Lesson

Converting between units is the process of starting with one unit and ending up with another unit. All formulas are boiled down to converting between a unit (or group of units) and ending with another unit. To convert units, you will find equivalents and either multiply them or divide by them. In this lesson we will show you how to make sure you have the right units and how to know when to multiply or divide.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- What a unit is
- What an equivalent is
- How are units and equivalents used to solve math problems
- Methods for converting units
- Common unit conversions required in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 11, "Conversions," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 11
- Complete the quiz for Lesson 11

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Lesson 12 – Graphs and Tables

Summary of This Lesson

Graphs and tables are simply a visual expression of data. In this lesson we will only cover the creation of simple graphs and tables and the method interpreting and using them.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to read and interpret graphs and tables
- The purpose of various graphs and tables used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 12, "Graphs and Tables," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 12
- Complete the quiz for Lesson 12

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Lesson 13 – Per Capita Water Use

Summary of This Lesson

Per capita water use is the measure of water use per person served. One way to express per capita use is gallons per capita per day (gpcd). We will cover calculating and using per capita water use in this lesson.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate per capita water use
- The importance and uses of per capita water use data in water system operations.

Assignments for This Lesson

- Read Mathematics Chapter 13, "Per Capita Water Use," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 13
- Complete the quiz for Lesson 13

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Lesson 14 – Domestic Water Use Based on Household Fixtures

Summary of This Lesson

Domestic water use generally makes up the largest portion of water use from a system. Common household fixture flow rates can be used to estimate the domestic water use.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of estimating domestic water use based on household fixtures
- How household fixture unit information is used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 14, "Domestic Water Use Based on Household Fixtures," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 14
- Complete the quiz for Lesson 14

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Lesson 15 – Water Use per Unit of Industrial Product Produced

Summary of This Lesson

Industrial production is generally measured by the product produced. Examples given in your textbook are 20,000 gallons per ton of green beans in a cannery and 43,000 gallons used per ton of paper. This information is used to calculate the expected water requirements by an industrial plant.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating water use per unit of industrial product produced
- How data on water use per unit of industrial product produced are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 15, "Water Use per Unit of Industrial Product Produced," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 15
- Complete the quiz for Lesson 15

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Lesson 16 – Average Daily Flow

Summary of This Lesson

Average daily flow is just the total flow of water divided by the total number of days. This is an average, not a projection or estimate. Your actual daily flow will be different. The average daily flow is the number used to represent the daily flow required by the community.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating average daily flow for a water system
- How average daily flow data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 16, "Average Daily Flow," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 16
- Complete the quiz for Lesson 16

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Lesson 17 – Surface Overflow Rate

Summary of This Lesson

Surface overflow rate is important in producing the best quality effluent. If the surface overflow rate is too high, there will be increased turbulence that results in suspended particles carrying over and not settling out. Surface overflow rate is calculated using the *surface area* not the weir length.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating surface overflow rate
- How surface overflow rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 17, "Surface Overflow Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 17
- Complete the quiz for Lesson 17

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Lesson 18 – Weir Overflow Rate

Summary of This Lesson

Weir overflow rate is the measure of water flowing over the weir. The weir is the length the water has to flow out of a tank (whether round or straight).

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating weir overflow rate
- How weir overflow rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 18, "Weir Overflow Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 18
- Complete the quiz for Lesson 18

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Lesson 19 – Filter Loading Rate

Summary of This Lesson

Filter loading rate is measured – in theory – much like surface overflow rate. You are calculating the flow based on the area. Only in this case, we are looking for the filter capacity and determining when a filter needs to be backwashed. Filter loading rate is calculated by the minute and not the day like surface overflow rate.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating filter loading rate
- How filter loading rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 19, "Filter Loading Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 19
- Complete the quiz for Lesson 19

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Lesson 20 – Filter Backwash Rate

Summary of This Lesson

It's important to know the backwash rate used in a filter because an excessive backwash rate will cause operational problems as will a backwash that's too slow. It is measured in gpm/ft^2 or inches of water rise/minute. Typical backwash rates vary from 15 gpm/ft^2 to 22 gpm/ft^2.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating filter backwash rate
- How filter backwash rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 20, "Filter Backwash Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 20
- Complete the quiz for Lesson 20

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Lesson 21 – Mudball Calculation

Summary of This Lesson

Monitoring and calculating mudball formation is important particularly with sand filters. Mudballs can cause operational problems and filter malfunctions. Mudballs are calculated as a percent in the sample taken.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating percent volume of mudballs in a filter
- How mudball calculation information is used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 21, "Mudball Calculation," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 21
- Complete the quiz for Lesson 21

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Lesson 22 – Detention Time

Summary of This Lesson

Detention time is the theoretical time a particle of water is in a tank or chamber. It is used for flash mixing, coagulation-flocculation, and sedimentation. It can be expressed as seconds, minutes, hours, or days. Most often seconds, minutes, and hours are used.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of determining detention time in a basin
- How detention time is used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 22, "Detention Time," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 22
- Complete the quiz for Lesson 22

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Lesson 23 – Well Problems

Summary of This Lesson

Well yield, drawdown, and specific capacity are the three primary well calculations. This information is used to select the appropriate equipment and make operational changes.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculation well yield, drawdown, and specific capacity
- How well calculations are used in water well operation and maintenance

Assignments for This Lesson

- Read Mathematics Chapter 23, "Well Problems," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 23
- Complete the quiz for Lesson 23