



WEAT Process Control Event 2014

Preliminary Rules

Event Philosophy

The purpose of the Process Control Event is to distinguish the relative process control skills of the teams so that points can be awarded proportionately.

Unlike most test situations, the expectation is not that all teams will complete all the questions. The goal is not to see who can answer all questions with the fewest mistakes. Instead, teams are given the opportunity to provide as many correct answers as they can in the allowed time. The test is designed to be long enough so that teams do not run out of questions to answer. The types and difficulty levels for questions are roughly matched to the points awarded for getting the correct answer. Solving the process scenario questions are usually worth more than the quick multiple choice questions. It is up to each team to develop a strategy to figure out which questions to answer in the time allotted to achieve the highest final score.

Showing work is required and emphasized because it allows distinction between knowing the right answer and guessing the right answer. Test graders can only see what is written by the team and cannot infer what was meant. Since the goal of the test is to demonstrate knowledge, graders need to see the steps used to arrive at an answer to a math question.

Overview

The Process Control Event for the 2014 WEAT Operations Challenge will be similar to the 2013 event. This year one of the process scenario problem sets will be mandatory. This is done to encourage study in a particular area of wastewater operation. Special scoring rules are used for these questions. Be sure to read the paragraphs on the Mandatory Scenario to avoid losing points.

The event consists of answering a number of multiple choice questions, some short math questions with multiple choice answers, and up to five operational type scenarios that have four to six questions each that may require considerable calculations. The event is timed, with a total of 25 minutes. The team can split up the test any way it chooses during the test. The team that scores the most points for correct answers will win.

Time is an important factor in taking the test. The total time available for each team for all portions of the test event is 25 minutes. The first portion of the test is a five minute test preview period. The second is 20 minutes for answering the questions.

Test Procedures

In preparation for the test, only the four team members are allowed at the table. Only pencils and non-programmable calculators are allowed. Phones, notes and any other materials are not allowed at the table.

Once the teams are in place, the tests are distributed. When instructed, the test envelope is opened and the test cover sheet is verified for team name and number and the team captain's name is filled out.

Five minute review period: During this time, the teams can open the test and examine all the questions and their point values. The teams may talk among themselves. **No marks of any kind may be made on any test page during this period or the team will receive an event score of zero.** By the end of the five minute review period the team must return all the pages to the envelope in whatever order they desire. Teams may fold pages together (within reason).

Twenty minute test: The second portion of the event follows immediately. At the signal, teams open the envelope and have twenty minutes to complete the test. All pages must be in the envelope at the end of twenty minutes.

Process Scenario Categories

Since all scenarios are written from scratch and created by volunteers, the final topics in the test may change slightly or a topic may be omitted.

The scenario problems will be chosen from the following processes:

- Secondary Treatment Suspended Media: includes biological nutrient removal
- Solids Stabilization Methods: Anaerobic Sludge Digestion
- Water Reuse/Reclamation: includes Membranes
- Pumping/Maintenance: includes energy conservation

Mandatory Scenario

To encourage work on the mandatory scenario, all questions in the mandatory scenario(s) start with negative points. If all the needed work is shown and the correct answer is circled, then full points, which is the positive value of the question, is given. For example, if a question starts at 60 points and is answered correctly with all work shown, the value is +60 points. Half credit will be given as described below. Half credit would result in a point value of zero for the question. The standards for receiving half credit on a mandatory question may be less stringent in terms of the amount of work that must be shown.

Grading

The tests will be graded as follows:

- multiple choice questions as: correct answer, incorrect answer, or no answer
- short math multiple choice questions as: correct, incorrect, or no answer as well as whether work is shown on test paper
- operational scenarios as: correct, incorrect, or no answer as well as whether work is shown on test paper

Scoring

Scoring in the Process Control event consists of adding all of the team's points for correct answers and any partial credit given in math problems. There is no time bonus or penalty for finishing before the 20 minute time limit.

There are no penalties for incorrect answers or not answering a question.

For the multiple choice and extended multiple choice questions, there are three possible results: no answer, incorrect answer, or correct answer. For no answer or incorrect answer, zero points are awarded. If the question is answered correctly the score is the point value of that question.

In general, multiple choice questions range from 10 to 30 points each. Extended multiple choice questions range from 25 to 50 points each. Point values are shown on each test page.

Math questions are handled in a similar manner with one additional requirement and one exception. The requirement is that a certain amount of work must be shown to receive any credit. If a correct answer is circled on a math question, but no work is shown, zero points are awarded for the effort. The exception is that even if there is no answer or the answer is incorrect, the team may receive half credit for that question **if** work is shown as described below. Short math questions range from 25 to 50 points each. Operational scenario questions may range from 25 to 200 points.

Grading of Questions (percent of question value awarded)				
Test section	Correct answer¹	No answer	Incorrect answer	Correct answer AND showing work
Multiple choice	100%	0	0	N/A
Extended multiple choice	100%	0	0	N/A
Short math multiple choice	0 ¹	50%*	50%*	100%*
Operational scenarios (except mandatory)	0 ¹	50%*	50%*	100%*

¹**For any math questions, there are no points for a correct answer if no work is shown.**

*Half credit for showing work as described below

If a Judge determines that a team member is not attempting to help with parts of the test, a 500 point penalty will be assessed for each non-participating team member.

Half Credit and Showing Work

For any math question, the team must write out the numbers used and show them in an equation form.

Example:

$$16 \text{ mg/l} \times 8.34 \times 2.4 \text{ MGD} = 320 \text{ lbs}$$

Simply writing down numbers does not count. The equation used must also be relevant to the question. e.g. there will not be credit for writing down the lbs formula when the question is about detention time. The work shown must be consistent with the operational theory described in the problem.

For the math and operational scenario questions, if the grader feels that the work shown demonstrates conceptually correct and significant, but incomplete, progress towards the answer the work shown may receive the half credit listed in the Points Table. If the work shown uses a conceptually incorrect approach half credit will likely not be awarded.

Note that in the Operational Scenarios, sometimes answers that are text rather than numbers may still require work to be shown. For example, if the correct answer for a problem is “the hydraulic loading rate is too high” then the work shown **must** include a calculation of the hydraulic loading rate.

The test grader can only use what the test taker writes down to determine how the test taker is attempting to solve the problem. Therefore it is the responsibility of the test taker to clearly show how the answer has been derived. The grader cannot infer missing steps in solving the problem. While labeling of units is not required, it is highly encouraged so that graders can better determine if partial credit is warranted.

Because each math problem is unique, the requirements of “significantly complete and conceptually correct” will be based on the content of the question. “Significantly complete” generally means that all but one step is shown or that only one mistake is made. “Conceptually correct” depends on the question and what it is asking. Most questions are designed to focus on one or two key elements of wastewater knowledge. For example, an f/m question focuses on food and mass. So if an answer doesn’t show BOD, or uses MLSS instead of MLVSS, a key element is missing and no half credit would be given.

Scope

The questions will cover the following areas of wastewater treatment as well as general topics such as: pumping, maintenance, laboratory, safety, flow measurement, and metering:

Process Areas	Example Systems
Preliminary Treatment	Screening Grit Removal Flow Equalization
Odor Control	Wet Chemical Scrubbing

Process Areas	Example Systems
	Chemical Addition Biofilters
Primary Treatment	Primary Sedimentation Flow Equalization Clarification
Secondary Treatment Suspended Media	Activated Sludge Biological Nutrient Removal Clarification Sequencing Batch Reactors
Secondary Treatment Fixed Media	Trickling Filtration Biological Nutrient Removal
Advanced Treatment	Filtration Biological Nutrient Removal
Thickening	Gravity Belt Thickener Dissolved Air Flotation Gravity Thickening
Solids Stabilization Methods	Anaerobic Digestion Aerobic Digestion
Dewatering	Belt Filter Press Drying Beds Centrifuge Dewatering
Disinfection	Chlorination \ Dechlorination Ultraviolet Disinfection
Management and Support	Process Instrumentation Treatment Plant Security

Resources

The following references will be used in creating and grading the test questions:

- Water Environment Federation Manual of Practice 11
- The monthly *Water Environment & Technology Operations Forum* WEF Skills Builder quiz: <http://www.wef.org/SkillsBuilder/>
- California State University Sacramento Operations of WWTPs volumes 1 & 2 and Advanced Waste Treatment
- Collections Systems questions will be based on the Sacramento Manual, Operations and Maintenance of Wastewater Collections Systems.
- Manual on the Causes and Control of Activated Sludge Bulking and Foaming, Jenkins, Richards & Daigger

Test Details

The same test is used for both Division 1 and Division 2.

The multiple choice test will consist of up to 42 questions with four possible answers each, fifteen multiple choice questions requiring a small amount of math, and 20 questions where each answer is chosen from a list of 20 possible answers (extended multiple choice).

Four or five process scenarios with three to six questions each are in the test. Teams may answer as many parts of any scenario that they desire.

Formula sheets, reference books or any other material are not permitted.

Team members may talk among themselves but may not be disruptive. Teamwork in solving problems is encouraged. Also consider that other teams may overhear your discussions.

General Details

What will be supplied at the event: Test question/answer sheet forms.

Competitors must supply their own pencils and calculators (calculators cannot have programming or printout capability). We will also try to have a pencil sharpener available prior to the event but this is not guaranteed.

All four team members must be present before the start of the event and participate during the event.

If a team is disqualified from the event they will receive a score based on the maximum time and every question left blank and no work shown.

Notes

The exact number of questions may change slightly between now and the event. The points may also be adjusted to ensure test balance.

Graders and event judges will not have reference books available at the event; plan on bringing your own copies as needed. (No reference material can be used during the test)

Process Control Event committee members will be available to discuss scoring of test questions at the designated time and location.