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UNDER PRESSURE

WORKBOOK

East Bay Municipal Utility District

2/16/2018

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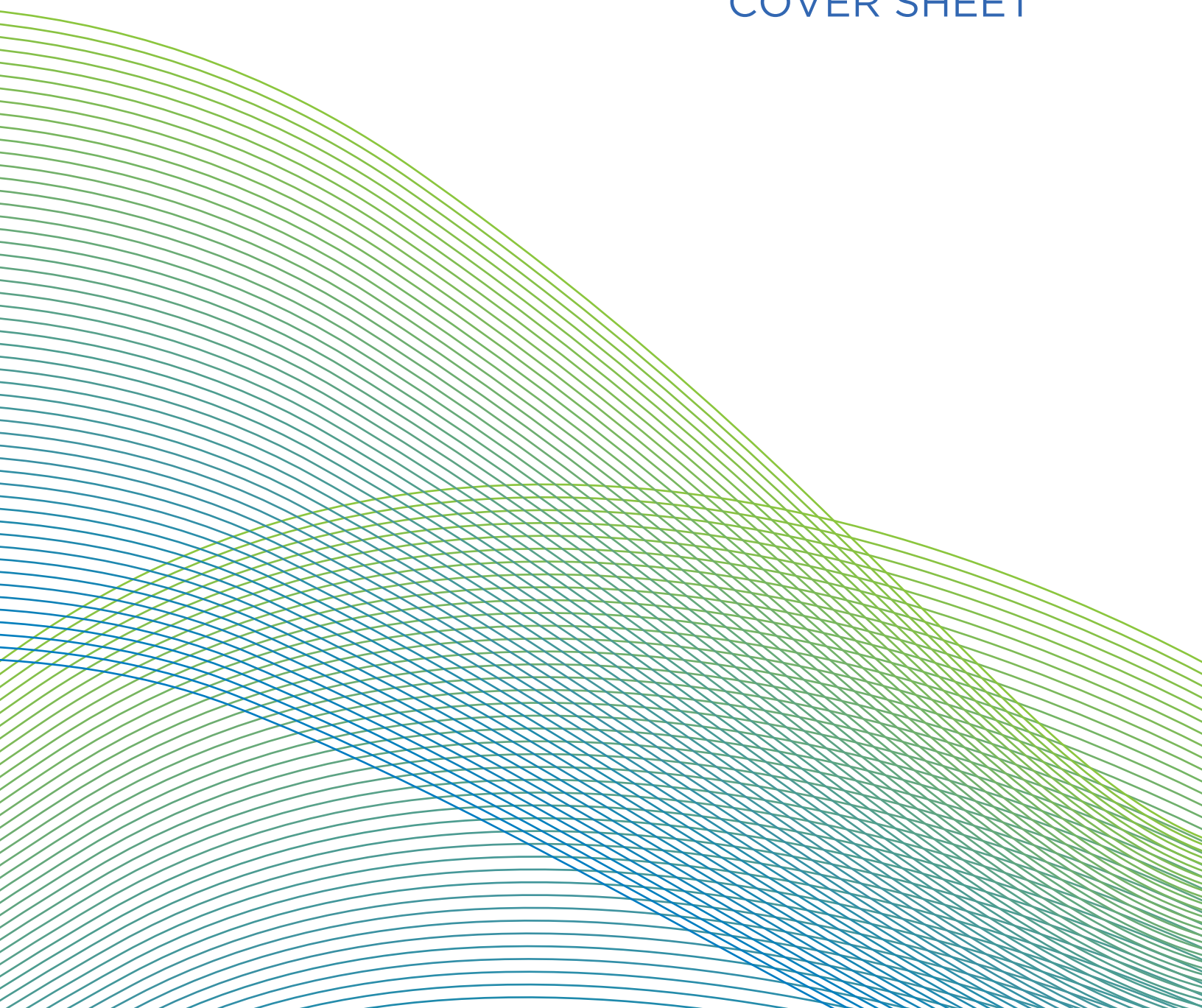
COVER SHEET



UNDER PRESSURE

Coversheet for Instructors

Introduction: The following material introduces students to computations involving percent and volume.

Materials:

Projector connected to a computer with internet to show video for the lesson

Copies of each of the following:

- Warm-up and Exit Ticket
- Under Pressure worksheet

Prior Knowledge/Skills Needed: see details below

Before this application lesson, students must be able to:

-Compute volume of a cylinder

-Apply percentage concepts

-Apply conversions

Water distribution operators must be able to view the level of water in their water tanks (commonly known as reservoirs) on their computer screens. The way water levels are determined, is by measuring the pressure at the bottom of the tank, and then converting that number (which is given in PSI, pounds per square inch) to a height.

Water levels are critically important for water management organizations because the utility is required to maintain a certain amount of water in reservoirs at all times. In case of a sudden large demand for water, greater than can be provided instantaneously, (as in the case of fire or even at times of day when consumers are using a lot of water simultaneously, like morning showers) the water district might need to provide additional volume beyond what is considered normal.

Instrument technicians are required to verify the accuracy of their measuring devices from time to time. The measurement readings must be reliable, in order for distribution operators to know exactly how much water is available.

Here are some terms and mathematical concepts that must be understood before a student can solve a problem involving water levels and instrumentation readings.

Volume: In this context we will be talking about the volume of a reservoir or water storage tank that is cylindrical in shape.

The volume of a cylinder is: $\pi r^2 h$ (where 'r' is the radius of the reservoir and 'h' is the height.) Make sure units are consistent. If radius is measured in feet, height should also be measured in feet.

Percent: General ability to apply percent concepts.

Conversion: 7.48 gallons of water = 1 cubic ft.

PSI (pounds per square inch)

1 PSI is defined as 27.7 inches of water. (the diameter of the container of water is not a factor) This is a reading of pressure exerted on the bottom of the tank by the water in it.

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WARM-UP EXERCISE

UNDER PRESSURE

Warm-Up:

1) If a tank that measures 120 inches in height is 65% full, how many inches of water does it contain? Express your answer two ways: in inches as well as in feet.

2) The volume of a cylindrical water tank is 3500 cu. ft.

a. How many gallons of water can it hold at full capacity?

b. What is the tank's diameter if the height is 10 ft?

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VIDEO

“Under Pressure” Video

May 11, 2016

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WORKSHEET

Problem pertaining to Fire Sciences/Water Pressure – “Under Pressure”

Background

Water distribution operators must be able to view the level of water in their water tanks (commonly known as reservoirs) on their computer screens. The way water levels are determined, is by measuring the pressure at the bottom of the tank, and then converting that number (which is given in PSI, pounds per square inch) to a height.

Water levels are critically important for water management organizations because the utility is required to maintain a certain amount of water in reservoirs at all times. In case of a sudden large demand for water, greater than can be provided instantaneously, {as in the case of fire or even at times of day when consumers are using a lot of water simultaneously, like morning showers} the water district might need to provide additional volume beyond what is considered normal.

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Contextualized Math problem

Assume a water tank has a height of 300 inches, and a diameter of 30 feet. When full, the tank will have a pressure of 300 inches of water. At the 50% level, this tank would have a pressure reading of 150 inches of water.

A water distribution operator's computer screen shows one of his 300-inch reservoirs is 75% full.

1) How many inches of water should we measure at the bottom of the reservoir?

2) How many feet of water?

3) How many PSI?

We know that the reservoir is 300 inches tall with a diameter of 30 feet.

4) What is the maximum capacity (in gallons) of the reservoir?

5) If the reservoir is 75% full, how many gallons are in it?

The level indicator on the side of the reservoir reads 25% full. There is a gauge at the bottom of the tank, which reads 5.1 PSI.

6) Is the gauge reading accurately?

7) If not, what should the gauge the reading?

Answers to Math questions:

1) 225 inches (.75 x 300)
2) 18.75 ft. (225 ÷ 12)
3) 8.12 PSI (225÷27.7)
4) 132,182.4 gallons {first find volume ($\pi r^2 h$), then convert to gallons}
5) 99,136.8 gallons {.75 x 132,182.4}
6) No
7) If gauge reads 5.1 PSI that suggests a water height of 141.27 inches. (5.1 x 27.7) But if this reservoir is only 25% full and it is 300" tall, then it has a water height of 75 inches, which converts to 2.71 PSI.

Warm-up:

1) If a tank that measures 120 inches in height is 65% full, how many inches of water does it contain? Express you answer two ways: in inches as well as in feet.

2) The volume of a cylindrical water tank is 3500 cu. ft.

a. How many gallons of water can it hold at full capacity?

b. What is the tank diameter if the height is 10 ft?

Exit Ticket:

1) In your own words described what you learned today.

2) How difficult did you find this problem?

3) What part of the problem was most difficult for you?

* Different from a naturally occurring reservoir?

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EXIT TICKET

UNDER PRESSURE

Exit Ticket:

1) In your own words described what you learned today. Try to use some of the technical terminology you heard in the video.

2) How difficult did you find this problem?

3) What part of the problem was most difficult for you?

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STUDENTS FEEDBACK FORM

Feedback Form for Students (Online)

Go here for the Online Version of Feedback Form:
https://goo.gl/forms/3vSjzMuzFDuxY1y73