Filling the Vase

T³
Teachers Teaching with Technology™
Professional Development from Texas Instruments

Answers

7 8 9 10 **11** 12

TI-Nspire   Investigation   Student   20 min

Teacher Notes / Comments

The purpose of this activity is to investigate average and instantaneous rate of change via a practical context, height of water in a container, including interpreting graphs of empirical data with respect to rate of change. A suitable and complimentary introduction is to watch a video (Free on YouTube) and collect data for the height of the water in the vase against time or volume. The video can be paused at any time to take a measure of the height of the liquid; the time can be captured using the YouTube time line for the video clip. Another option is to have students create their own video and use it to collect data.

Conceptually students focus on: "Is the height changing rapidly for a given change in volume" or "Is the height changing slowly for a given change in volume?" No formal calculus is required. In the TI-Nspire file, students work from the vase and generate the graph then the reverse, work from the graph to produce the corresponding vase.

Introduction

Pipettes are commonly used in the science lab to dispense a *precise* volume of liquid. The large region in the middle of the pipette holds most of the liquid, the line near the top occurs in a very narrow section so a small change in volume will represent a significant variation in the height of the liquid in that region. It takes some time to become proficient at filling a pipette as the liquid progresses slowly through the larger middle region but rapidly through the narrow upper section.

The purpose of this activity is to connect the shape of a variety of vessels with their height versus volume curve and corresponding rate of change during the filling process.

Getting Started

Open the TI-nspire document "Fill the Vase" and navigate to page 1.3.
The image on page 1.3 shows a vase being filled with water.
The amount of volume can be changed using the slider on the top left corner.
The corresponding height and volume are shown numerically (top of page), visually (left: vase) and graphically.
The shape of the vessel can be changed by dragging the points on the left side of the vase.
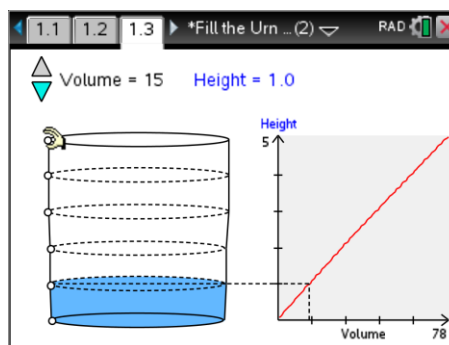
To grab a point on the side of the vase, move the mouse over the point until it changes to an open hand. Click once on the centre of the navigation pad to grab it, move the point to its new location then click once again to release.

TEXAS INSTRUMENTS

Question: 1.

Sketch a graph of the height vs volume graph for the vase shown below. To check your answer, adjust the sides of the vase in the TI-Nspire document to match the image shown.
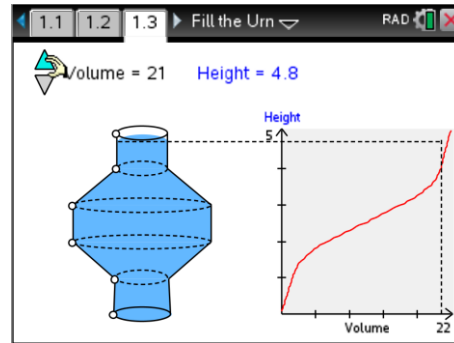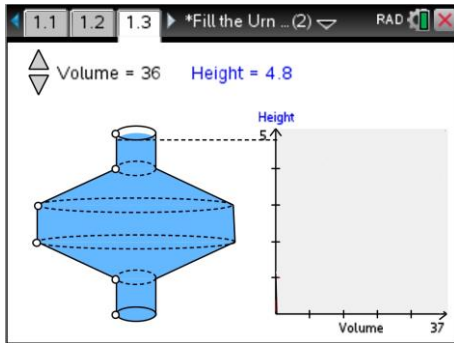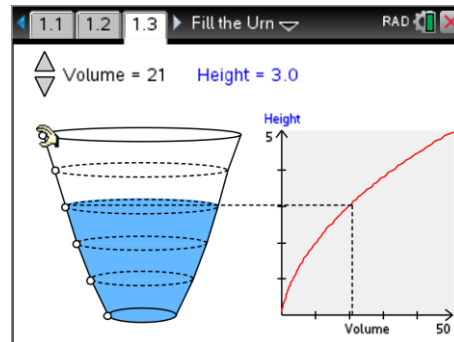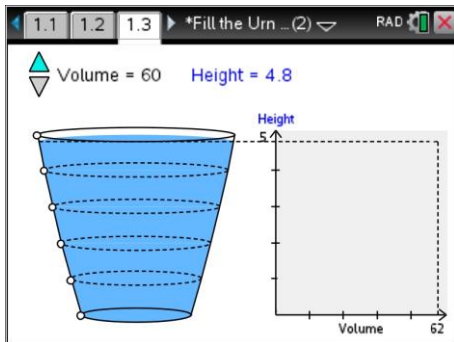

Question: 2.

Imagine water is being poured into the vessel at a constant rate, in what sections of the vessel will the water rise most rapidly.

The water will rise at the fastest rate where the vase is at is narrowest.

Question: 3.

Sketch a graph of the height vs volume graph for the vase shown below. To check your answer, adjust the sides of the vase in the TI-Nspire document to match the image shown.
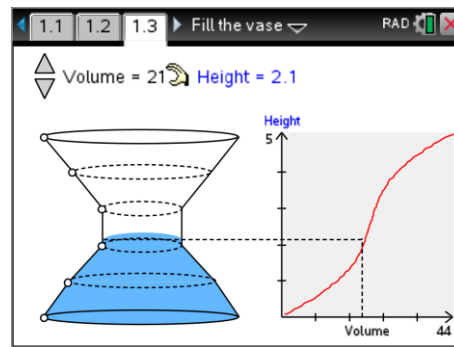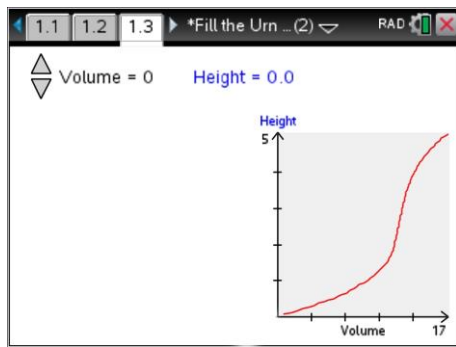

Question: 4.

A graph of the height vs volume has been produced for a vase. Draw the shape of the vase that could produce such a graph. Create the vase on the TI-Nspire document to check your answer.
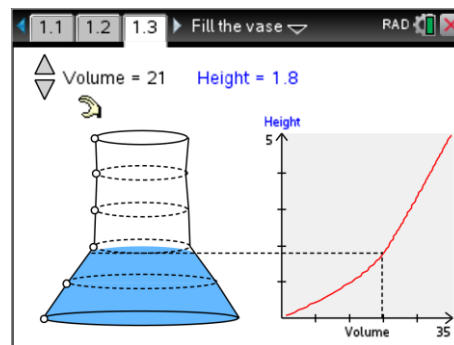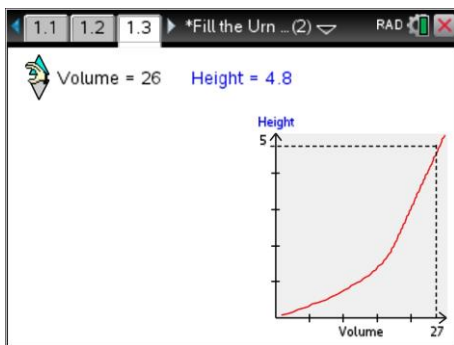
Question: 5.   A graph of the height vs volume has been produced for a vase. Draw the shape of the vase that could produce such a graph. Create the vase on the TI-Nspire document to check your answer.

Question: 6.

Imagine the water is now released from the vessel at a constant rate, the same rate at which it entered. Extend the graph to show the change in height with respect to volume.

The graph will be a mirror image reflected along the line V = 44 (full).

TEXAS INSTRUMENTS