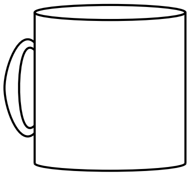
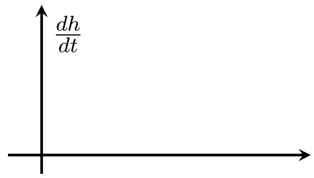
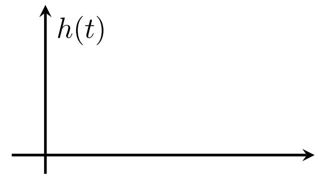
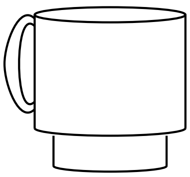
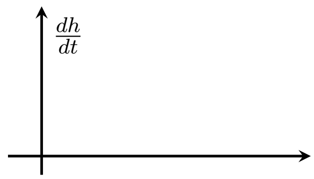
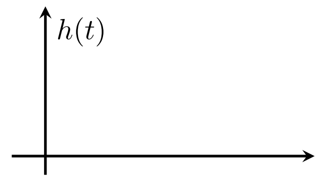
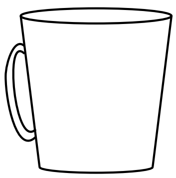
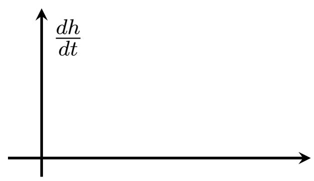
Coffee is being poured at a constant rate into coffee cups. Give a rough graph of the rate of change of the height of the coffee in the cup as a function of time and a rough graph of the height of the coffee in the cup as a function of time.

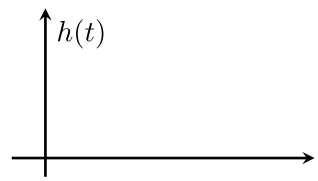



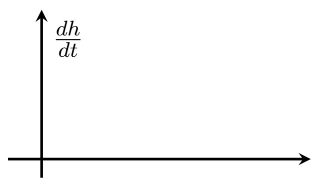


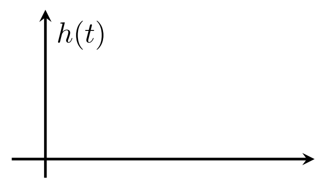



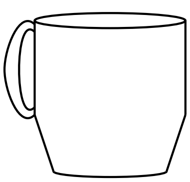
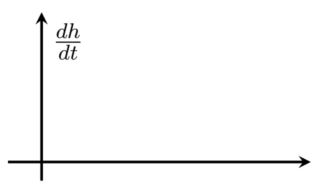


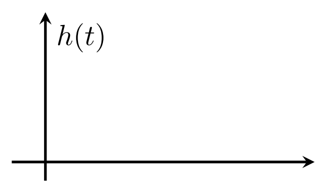



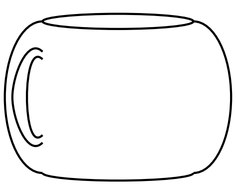
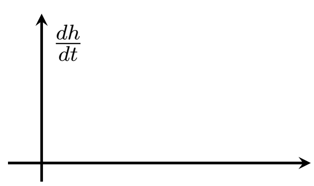


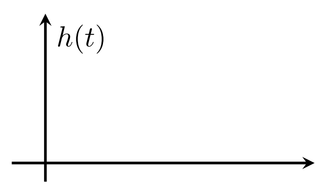



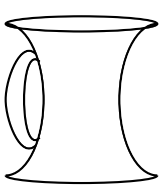
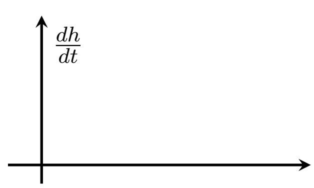


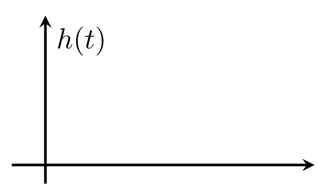



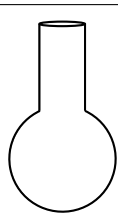


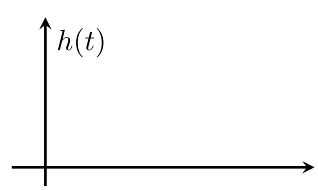









For each of the following questions, discuss with your group the answer to the question, then check that your graphs reflect your answer. Go back and edit your graphs if needed.

1. What is the domain of $h(t)$ and dh/dt (for any cup)?

2. Eventually each of the cups will become completely full. What happens to $h(t)$ and dh/dt if the coffee continues to be poured?

3. Consider the second cup. What happens to dh/dt the moment the coffee reaches the height where the radius of the cup changes?

4. What is the relationship between $r(h)$, the radius of the cup at a height h, and dh/dt? That is, if $r(h)$ is increasing (or decreasing) what happens to dh/dt? (Hint: Look at cups 3 and 4.)

5. Imagine the third cup is infinitely tall. What is the end behavior of $h(t)$ and dh/dt?

6. Can there be a cup where the graph of dh/dt has a discontinuity? If so, what kinds of discontinuities are possible?

7. Can there be a cup where the graph of $h(t)$ has a discontinuity? If so, what kinds of discontinuities are possible?