

EMCH-745 CFD Homework 1

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Question 1: See attached “sessile.cpp” file.

Question 2: The nondimensionalized height, H^* , of the droplet for a single case (Bond # = 2, contact angle=110) was studied for different time-step sizes, $ds^* = 5, 2, 1, 0.1, 0.01$. Figure 1. shows the results, with the x-axis in logscale. H^* varies a lot between 5, 2, and 1 but remains relatively constant after 0.1. Therefore, the following simulations were run with $ds^* = 0.1$.

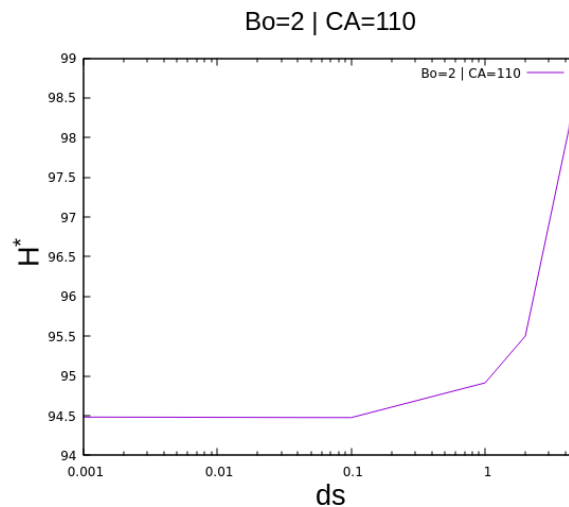


Figure 1. Height of sessile droplet for varying time-step sizes.

Question 3: The effect of contact angles (CA) has on the droplet for each bond number (BO) is shown in Figure 2. Throughout all BO numbers, the height of the droplet increases with contact angle. This increase in droplet height is associated with the natural extension of the interface, i.e. the rate of curvature for the droplets are identical leading up to the point of contact.

Conversly, the height and width of the droplet decreases with BO number with contact angle held constant, see Figure 3. This effect is significant compared to the increase in height caused by the change in CA as displayed in Figure 2. The increase in height and width can be explained by the increase of gravity, as used in the BO formula, increasing. A strong gravitational force, or a weak surface tension force, will compress the droplet and is associated with a larger BO number.

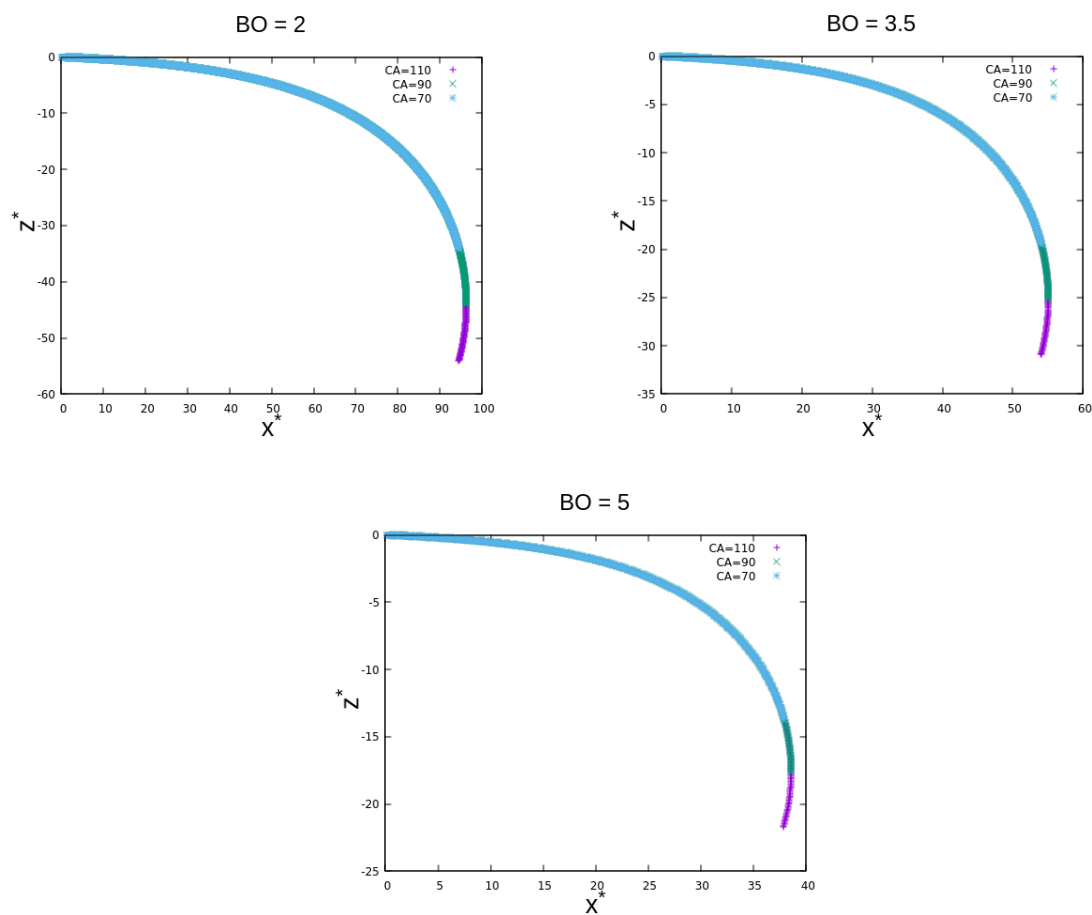
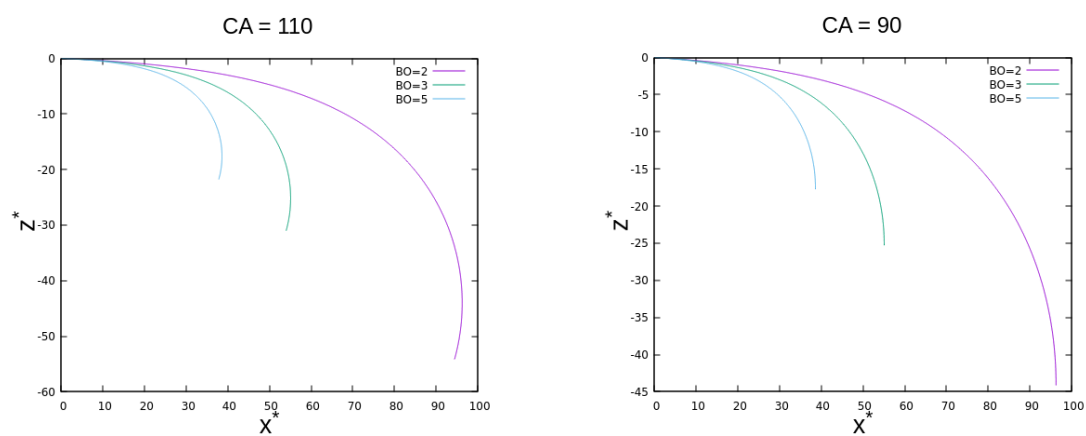


Figure 2. Shape of sessile drop for the three BO numbers with varying contact angles.



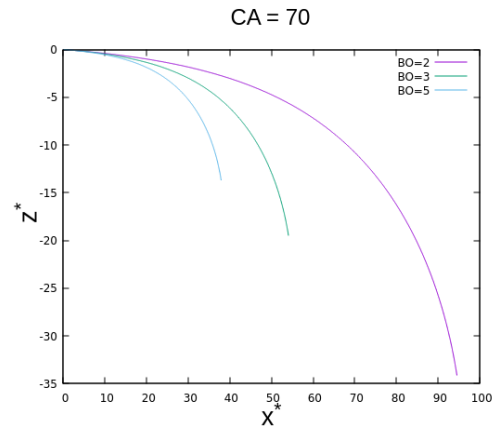


Figure 3. Shape of sessile drop for the three contact angles with varying BO numbers.

Question 4: Using the given information, a BO number of 0.436 was calculated. Using that and the CA of 107 degrees, the dimensionless height of the sessile drop is predicted to be 240.894, see Figure 4.

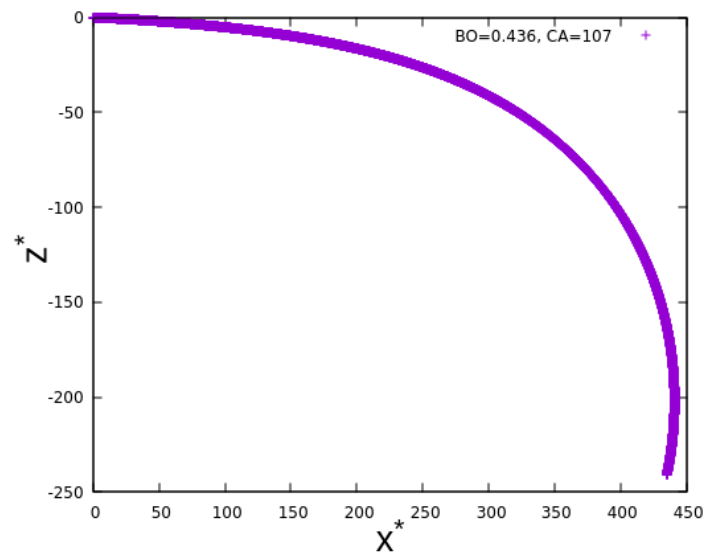


Figure 4. Predicted droplet shape for experiment in reduced gravity.