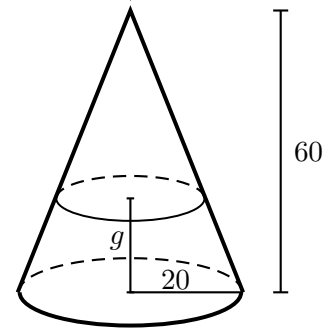


4. [12 points]

Having taken care of Sebastian and sent Erin into the hands of the *Illumisqati*, King Roderick is pleased that his plan is proceeding well. Our wicked villain decides to relax with a handmade chocolate before he heads to his farmhouse. The process of making the chocolate involves pouring molten chocolate into a mould. The mould is a cone with height 60 mm and base radius 20 mm. Roderick places the mould on the ground and begins pouring the chocolate through the apex of the cone. A diagram of the situation is shown on the right.

Chocolate poured in here



In case they are helpful, recall the following formulas for a cone of radius r and height h :

$$\text{Volume} = \frac{1}{3}\pi r^2 h \quad \text{and} \quad \text{Surface Area} = \pi r(r + \sqrt{h^2 + r^2}).$$

- a. [6 points] Let g be the depth of the chocolate, in mm, as shown in the diagram above. What is the value of g when Roderick has poured a total of $20,000 \text{ mm}^3$ of chocolate into the mould? *Show your work carefully, and make sure your answer is accurate to at least two decimal places.*

Answer: $g \approx$ _____

- b. [6 points] How fast is the depth of the chocolate in the mould (g in the diagram above) changing when Roderick has already poured $20,000 \text{ mm}^3$ of chocolate into the mould if he is pouring at a rate of $5,000 \text{ mm}^3$ per second at this time? *Show your work carefully and make sure your answer is accurate to at least two decimal places. Be sure to include units.*

Answer: _____