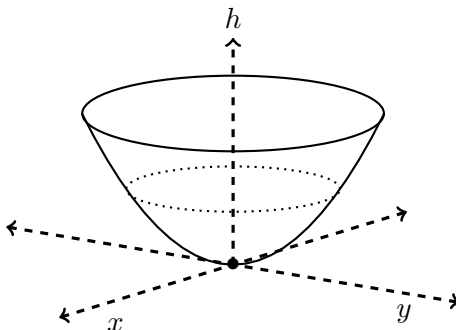


10. [10 points] Martin is having a party to celebrate the beginning of spring and he is serving punch out of a parabolic punch bowl. The bowl is sitting on a table (the xy -plane) as depicted in the figure below. At a height h above the table, the cross section of the bowl perpendicular to the h -axis is a circle with equation, $h = 4x^2 + 4y^2$. The punch bowl is 1 meter tall. Assume the units of x , y , and h are in meters and the density of the punch is 1200 kg/m^3 . Recall the gravitational constant is $g = 9.8 \text{ m/s}^2$.



- a. [5 points] Write an expression for the mass of a slice of punch of thickness Δh meters at a height h meters above the table.
- b. [5 points] Assuming the bowl is filled with punch up to a height of $h = 1/2$, write an integral which gives the amount of work needed to lift all of the punch over the rim of the bowl. Do not evaluate your integral.