- This exam is worth 100 points and has 5 problems.
- Show all work and simplify your answers! Answers with no justification will receive no points unless otherwise noted.
- Begin each problem on a new page.
- **DO NOT LEAVE THE EXAM UNTIL YOUR HAVE SATISFACTORILY SCANNED AND UPLOADED YOUR EXAM TO GRADESCOPE.**
- You are taking this exam in a proctored and honor code enforced environment. No calculators, cell phones, or other electronic devices or the internet are permitted during the exam. You are allowed one 8.5"$\times$ 11" crib sheet with writing on one side.

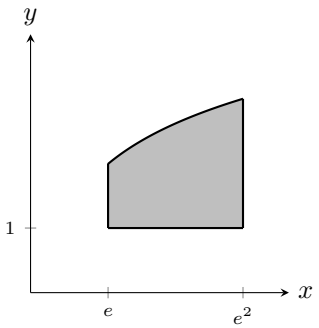
0. At the top of the first page that you will be scanning and uploading to Gradescope, write the following statement and sign your name to it: "I will abide by the CU Boulder Honor Code on this exam." **FAILURE TO INCLUDE THIS STATEMENT AND YOUR SIGNATURE MAY RESULT IN A PENALTY.**

1. [2350/070626 (15 pts)] Evaluate $\displaystyle\int_0^1 \int_{\sqrt[3]{z}}^1 \int_0^{\ln 3} \frac{\pi e^{2x}\sin(\pi y^2)}{y^2}\,\mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z$

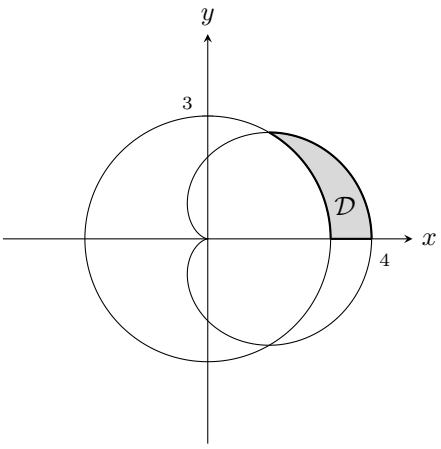
2. [2350/070626 (15 pts)] A thin metal plate (lamina) is placed on the xy-plane. It's shape is shown in the figure below with the curved upper portion described by $y = 1 + \ln x$. The plate's density is $\rho(x, y) = \sqrt{xy^3}$. Carefully follow the directions below and simplify your answers.

   (a) Set up, but **do not evaluate**, an appropriate double integral using the order $\mathrm{d}x\,\mathrm{d}y$ that will give the lamina's moment of inertia about the x-axis.

   (b) Set up, but **do not evaluate**, an appropriate double integral using the order $\mathrm{d}y\,\mathrm{d}x$ that will give the lamina's moment of inertia about the y-axis.



3. [2350/070626 (23 pts)] You have built a new clubhouse whose floor (lying in the xy-plane) is in the shape of the shaded region $\mathcal{D}$ in the accompanying figure. The curves shown in the figure are $x^2 + y^2 = 9$ and $r = 2(1 + \cos\theta)$. The roof of the clubhouse is given by $f(x, y) = \dfrac{8y}{x^2 + y^2}$. Determine the volume of the clubhouse by evaluating an appropriate double integral.



MORE PROBLEMS BELOW/ON REVERSE

4. [2350/070626 (24 pts)] The charge density on a metal plate is given by $q(x, y) = 6x^2y^2$ coulombs per square meter. The plate occupies the first quadrant region bounded by $xy = 1$, $xy = 2$, $y/x = 1$, and $y/x = 4$. Find the total charge on the plate, including appropriate units in your answer.

5. [2350/070626 (23 pts)] Consider the solid region, $\mathcal{W}$, shown below, which is a portion of the cone $x^2 + y^2 - \left(\frac{z}{3}\right)^2 = 0$. Suppose that the density, $\delta(x, y, z)$, of the region's material at each point in the solid is equal to the distance between the point (x, y, z) and the origin. Set up, but **do not evaluate**, triple integral(s) using the order shown that will compute the mass of the solid. To receive full credit, you must use the correct bounds for the figure as shown (study it carefully), not bounds for an equivalent solid in a different octant.

(a) $\mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z$ (b) $\mathrm{d}z\,\mathrm{d}r\,\mathrm{d}\theta$ (c) $\mathrm{d}\rho\,\mathrm{d}\theta\,\mathrm{d}\phi$