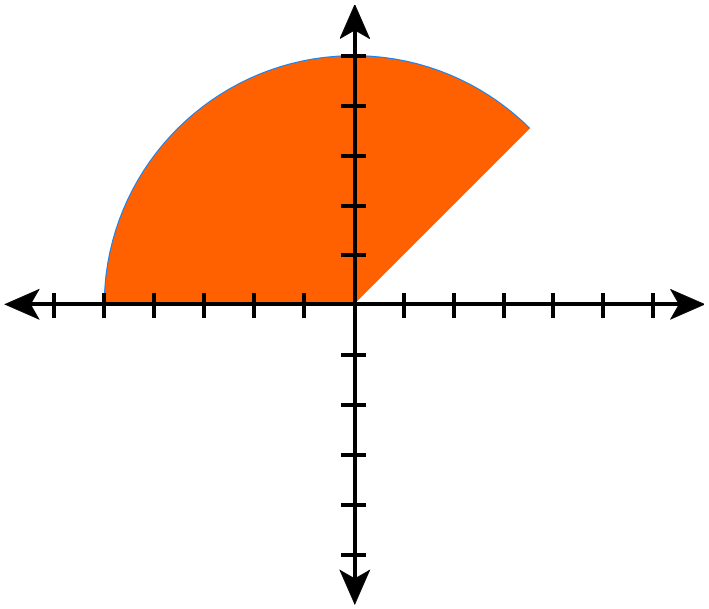
**Exam 2 Calc 3 10/22/2021**

Each problem is worth 10 points. For full credit provide complete justification for your answers. All integrals should be set up in terms of a single coordinate system, i.e., if you use cylindrical your integral should involve no $x$ or $y$, etc.

1. Write a double Riemann sum for $\iint_R f\,dA$, where $R = \{(x, y) : 1 \le x \le 5, 2 \le y \le 8\}$ using midpoints with $n = m = 2$ subdivisions.

2. Kansas is close enough to a rectangle 400 miles from west to east and 200 miles from south to north. Suppose that in some year the wheat harvest in Kansas is given by $w(x, y) = 4000 + 10x + 15y$ bushels per square mile, where we consider Kansas to be located on a standard coordinate system with the southwest corner positioned at (0,0). Set up a double integral for the total wheat harvest in Kansas for this year.

3. Set up an iterated integral for the total mass of a plate shaped like the region shown below, with density $\rho(x, y) = 5$.



4. Set up an iterated integral for the volume of the region under $z = 36 - x^2 - y^2$ but above the $xy$-plane.

5. Evaluate $\int_0^4 \int_{\sqrt{y}}^2 \sqrt{x^3+1}\, dx dy$.

6. Show that the Jacobian for the conversion from rectangular to polar coordinates is what it is.

7. Bunny is a calculus student at Enormous State University, and she's having some trouble. Bunny says "OMG! Calc 3 is just so much! It's like, there's a,lways another thing, right? So like why would I ever*ever**ever*** use spherical coordinates for anything? I mean you can totally do a sphere in cylindrical coordinates, right? Just stop already!"

   Explain clearly to Bunny when there might be situations in which spherical coordinates should be appreciated.

8. Evaluate $\int_0^2 \int_0^{\sqrt{4-x^2}} \int_0^{\sqrt{4-x^2-y^2}} 6\,dz\,dy\,dx$.

9. Set up an iterated integral to integrate $f(x,y,z) = 12xz$ over the region in the first octant above the parabolic cylinder $z = y^2$ and below the paraboloid $z = 8 - 2x^2 - y^2$.

10. A lamina occupies the part of a disk $x^2 + y^2 \leq 1$ in the first quadrant. Set up iterated integrals to find the center of mass if the density at any point is proportional to its distance from the $x$-axis.

Extra Credit (5 points possible): Find the center of mass of the lamina from #10.