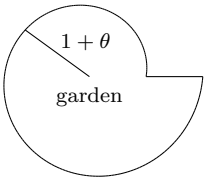
Name: _____

Directions: Show all work. No credit for answers without work. This test has 110 points but scores will be taken out of 100.

1. **[15 points]** Evaluate $\int_0^{\pi/2} \int_0^1 (\sin x) e^y \, dy \, dx$.

2. **[15 points]** Let D be the region bounded by the parabolas $x = 1 - y^2$ and $x = y^2 - 1$. Evaluate $\iint_D y^2 \, dA$.

3. **[15 points]** An spiral-shaped fence encloses a modern garden containing the origin $(0, 0)$. The fence is described by the polar equation $r = 1 + \theta$ for $0 \leq \theta \leq 2\pi$. Find the area of the garden.



4. **[15 points]** Evaluate $\int_0^6 \int_{y/2}^3 y \cos(1 + x^3)\, dx\, dy$. Hint: interpret as a double integral over a region and change the order of integration.

5. **[15 points]** A lamina of uniform density occupies the semi-circular region D consisting of all points (x, y) such that $x^2 + y^2 \leq 1$ and $y \geq 0$. Find the center of mass.

6. **[5 points]** What does it mean for a vector field to be conservative?

7. **[15 points]** Evaluate $\iiint_E e^{(x^2+y^2+z^2)^{3/2}}\, dV$, where E is the solid enclosed by the sphere $x^2 + y^2 + z^2 = 9$ in the first octant (where x, y, and z are all at least zero).

8. **[15 points]** Evaluate $\int_C xy^2\, ds$ where C is the curve given by $\vec{r}(t) = (2\sin t)\vec{i} + (2\cos t)\vec{j} + 3t\vec{k}$ for $0 \leq t \leq \pi$.