Name: _____

Please show all work and justify your answers. Supply brief narration with your solutions and draw conclusions.

1. Use cylindrical coordinates to integrate $(x^2 + y^2 + 3z^2)\, dx\, dy\, dz$ over the solid $x^2 + y^2 \leq 4,\ -2 \leq z \leq 1$.

2. Either find a scalar potential for F or explain why it fails to exist, where
   $$\text{(a) } F = [y, -x, 0] \qquad \text{(b) } F = [x, y, z]$$

3. Either find a vector potential for F or explain why it fails to exist, where
   $$\text{(a) } F = [2x, -y, -z] \qquad \text{(b) } F = [3x, -y, -z]$$

4. Use Green's theorem to calculate the area under one arch of the cycloid $[x, y] = [t - \sin t, 1 - \cos t]$ pictured below.
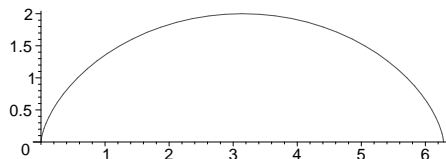
   Hint: Find a 1-form ω such that $d\omega = dx\, dy$ and recall that $\displaystyle\int_\Omega d\omega = \int_{\partial\Omega} \omega$

5. Find the flux of $[7x, 8y, 9z]$ through the unit sphere.

   Hint: Don't do it directly. ☺

	1	2	3	4	5	total (50)	%

Prelim. course grade: _____ %