1. Evaluate the path integral \( \int_C f(x, y, z) \, ds \) for
   (a) \( f(x, y, z) = x \cos z \), \( C : r(t) = ti + t^2j, 0 \leq t \leq 1. \)
   (b) \( f(x, y, z) = \frac{x+y}{y+z} \), \( C : r(t) = (t, \frac{2}{3}t^{3/2}, t), 1 \leq t \leq 2. \)

2. (a) Show that the integral \( \int_C f(x, y) \, ds \) along the curve \( C \) given in polar coordinates by \( r = r(\theta), \theta_1 \leq \theta \leq \theta_2 \), is
   \[
   \int_{\theta_1}^{\theta_2} f(r(\theta) \cos \theta, r(\theta) \sin \theta) \sqrt{r(\theta)^2 + \left( \frac{dr}{d\theta}(\theta) \right)^2} \, d\theta
   \]
   (b) Compute the arc length of \( r = 1 + \cos \theta, 0 \leq \theta \leq 2\pi \). You may use the formula
   \[
   1 + \cos \theta = 2 \cos^2 \frac{\theta}{2}
   \]
to simplify the computation.

3. Evaluate \( \int_C \mathbf{F} \cdot d\mathbf{r} \) for
   (a) \( \mathbf{F}(x, y) = xy\mathbf{i} - x^2\mathbf{j} \) along \( y = x^2 \) from \((0, 0)\) to \((1, 1)\).
   (b) \( \mathbf{F}(x, y, z) = (x - z)\mathbf{i} + (y - z)\mathbf{j} - (x + y)\mathbf{k} \) along the polygonal path from \((0, 0, 0)\) to \((1, 1, 0)\) to \((1, 1, 1)\).

4. Find the work, \( \int_C \mathbf{F} \cdot d\mathbf{r} \), done by the force field \( \mathbf{F} = (x + y)\mathbf{i} + (x - z)\mathbf{j} + (z - y)\mathbf{k} \) in moving an object from \((1, 0, -1)\) to \((0, -2, 3)\). Does the work done depend on the path used to get from \((1, 0, -1)\) to \((0, -2, 3)\)?

5. Evaluate \( \int_C x^2 y^2 \, dx + x^3 y \, dy \) counterclockwise around the square with vertices \((0, 0)\), \((1, 0)\), \((1, 1)\) and \((0, 1)\).

6. Let \( C \) be the curve from \((0, 0, 0)\) to \((1, 1, 1)\) along the intersection of the surfaces \( y = x^2 \) and \( z = x^3 \).
   (a) Find \( \int_C \rho \, ds \) if \( s \) is arc length along \( C \) and \( \rho = 8x + 36z \).
   (b) Find \( \int_C \mathbf{F} \cdot d\mathbf{r} \) if \( \mathbf{F} = \sin y\mathbf{i} + (x \cos y + z)\mathbf{j} + (y + z)\mathbf{k} \).

see over
7. Consider the four vector fields sketched below. Exactly one of those vector fields is conservative. Determine which three vector fields are not conservative and explain why.

(a)

(b)

(c)

(d)

Reminder: Midterm I is scheduled for Wednesday, February 7.