1) Compute the following triple integral

$$\int_0^1 \int_0^x \int_{-1}^{y^2} (x + 2y^2)\, dz\, dy\, dx$$

2) Calculate integral by changing order of integration:

$$\int_0^1 \int_y^1 x^2 e^{xy}\, dx\, dy$$

3) Show that the vector field is conservative for $x, y > 0$ and find a potential function:

$$\vec{F}(x,y,z) = \frac{ln\, y\, sin\, z}{2\sqrt{x}}\,\vec{i} + \frac{\sqrt{x}\, sin\, z}{y}\,\vec{j} + \sqrt{x}\, ln\, y\, cos\, z\,\vec{k}$$

4) Calculate the line integral from a parameterization

$$\int_\gamma xy\, dx + y^2\, dy$$

where γ is parameterized as $\vec{r}(t) = t^2\,\vec{i} + \sqrt{t}\,\vec{j}$, $1 \le t \le 9$.

5) The following is an exact line integral. Compute it on the path γ given in cylindrical coordinates as $r = \frac{1}{2}\theta, z = \theta$ for $0 \le \theta \le 8\,\pi$. Draw a graph of γ.

$$\int_\gamma 2xy\, cos\, z\, dx + x^2\, cos\, z\, dy - x^2 y\, sin\, z\, dz$$

6) Calculate curl and divergence of the following vector field:

$$\vec{F}(x,y) = sin\, y\,\vec{i} + x\,\vec{j} + z^2\,\vec{k}$$

7) Convert to cylindrical coordinates and evaluate

$$\int\int\int_{\mathcal{R}} \frac{z}{(x^2+y^2+z^2)^{\frac{5}{2}}}\, dV$$

where $\mathcal{R}$ is $\{(x,y,z) | x^2 + y^2 \le 1, z \ge 1\}$.

8) Write down, but do not evaluate, an expression in spherical coordinates which finds the volume of the region $x^2+y^2+z^2 \le 4$ and $-1 \le z \le 1$. You will need a sum of integrals!

9) Find the limits in the second integral

$$\int_{0,\pi/2} \int_0^{x^2} \int_0^{cos\, x} f(x,y,z)\, dz\, dy\, dx = \int_?^? \int_?^? \int_?^? dx\, dy\, dz$$

10) Compute the following double integral:

$$\int\int_{\mathcal{R}} y - x^2\, dA$$

over the region $\mathcal{R}$ defined by $1/x \le y \le 8/x$ and $x^2 \le y \le 3 + x^2$ by using substitutions to change the variables. (hint: put all x's and y's in the middle of the inequalities).