Please answer the following questions. **Answers without justifying work will receive no credit.** Partial credit will be given as appropriate, do not leave any problem blank.

1. (5 points) For an arbitrary continuous function $f(x, y)$ write down the equivalent iterated integral in the opposite order of integration to the one shown below.

$$\int_{0}^{2} \int_{0}^{x^2} f(x, y) \, dy \, dx$$

2. (10 points) For an arbitrary continuous function $f(x, y, z)$ convert the following triple integral to spherical coordinates.

$$\int_{-2}^{2} \int_{0}^{\sqrt{4-y^2}} \int_{0}^{\sqrt{4-x^2-y^2}} f(x, y, z) \, dz \, dx \, dy$$
3. (10 points) Determine if the following vector field is conservative. If it is, find a potential function.

\[ \mathbf{F}(x, y) = \langle x^2 - y, x - y \rangle \]

4. (12 points) Find the volume of the region above the \( xy \)-plane and below \( z = 4 - x^2 - y^2 \) in the first octant.
5. (10 points) Evaluate the line integral

\[ \int_C xz \, ds \]

where \( C \) is the line segment from \((2,1,0)\) to \((2,0,2)\).

6. (10 points) Evaluate the triple integral

\[ \iiint_Q e^{\sqrt{x^2+y^2+z^2}} \, dV \]

where \( Q \) is bounded by \( x^2 + y^2 + z^2 = 2 \) and the \( xy \)-plane.
7. (10 points) If $\mathbf{F}(x, y) = (xe^{x^2} - 2)i + (\sin y)j$ find the work done moving along $y = x^2$ from $(-2,4)$ to $(2,4)$.

8. (10 points) Compute the volume of the solid region bounded by the following surfaces.

$$z = y^2, \quad z = 1, \quad 2x + z = 4, \quad x = 0$$
9. (13 points) Use Green’s Theorem to evaluate the following line integral.

\[ \int_C (xy - e^{2x})\,dx + (2x^2 - 4y^2)\,dy, \]

where \( C \) is formed by \( y = x^2 \) and \( y = 8 - x^2 \) oriented clockwise.

10. (10 points) For what values of constants \( b \) and \( c \) will the following vector field be conservative?

\[ \mathbf{F}(x, y, z) = (y^2 + 2cxz)\mathbf{i} + y(bx + cz)\mathbf{j} + (y^2 + cx^2)\mathbf{k} \]