1. The equation $xy^2 + y\cos x - 1 = 0$ **implicitly** defines y as a function of x near the point $(0, 1)$. Use the technique covered in class to find $\dfrac{dy}{dx}$ at this point. Show your work to receive credit.

   Hint: The equation is of the form $F(x, y) = 0$.

2. **Set up** an **iterated double integral** for $\iint_R f\ dA$ where $f(x, y) = y\sin(x)$ and where R is the region in the first quadrant between the curves $y = 4x^2$ and $y = x^3$

3. **Set up** a triple integral in **spherical coordinates** for $\iiint_D f\ dV$ where $f(x, y, z) = x^2 + y^2 + z^2$ and where D is the region between spheres of radius 2 and 4 centered at the origin.

4. **Set up** a double integral in **polar coordinates** that gives the area of the region in the first quadrant bounded by the x axis and by the polar curve $r = 2\cos 2\theta$.

5. **Set up** an integral that gives the **surface area** of the part of the surface $z = 9 - x^2 - y^2$ that lies above the circle of radius 2 centered at the origin in the xy plane.

6. **Set up** an **iterated triple integral** for $\iiint_D f\ dV$ where $f(x, y, z) = x^2\cos(yz)$ and where D is the solid region bounded by the planes $x = 0$, $y = 0$, $z = 0$, $z = 4 - y$, and $y = 4 - x$.

7. The reduced row echelon form of the augmented matrix associated with a linear system in variables x, y, and z is

$$\left(\begin{array}{ccc|c} 1 & 2 & 0 & 2 \\ 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 0 \end{array}\right)$$

   Write down the **solution set** to this system.

8. You are given that the first matrix below has reduced row echelon form equal to the second matrix. $\begin{pmatrix} 1 & 1 & 3 \\ 3 & 1 & 7 \\ 2 & -1 & 3 \end{pmatrix} \sim \begin{pmatrix} 1 & 0 & 2 \\ 0 & 1 & 1 \\ 0 & 0 & 0 \end{pmatrix}$. Use this information to determine if the set of column vectors below is linearly independent.

   $\left\{ \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix}, \begin{pmatrix} 3 \\ 7 \\ 3 \end{pmatrix} \right\}$. Explain your answer.

9. $\begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix}$ is an eigenvector of the matrix $\begin{pmatrix} -7 & 8 & -3 \\ -13 & 14 & -3 \\ -11 & 8 & 1 \end{pmatrix}$. What is the associated **eigenvalue**?

   Note: You do not need to compute all the eigenvalues to answer this. Show all your work.

10. The number 2 is an eigenvalue of the matrix $\begin{pmatrix} 1 & -1 \\ -2 & 0 \end{pmatrix}$. Find **all eigenvectors** associated with this eigenvalue using the method covered in class. Show all your work.