Math 241, Final Exam, Fall, 2017 11:40 class

Write everything on the blank paper provided. **PLEASE RETURN this piece of paper.** If possible: return the problems in order (use as much paper as necessary), use only one side of each piece of paper, and leave 1 square inch in the upper left hand corner for the staple. If you forget some of these requests, don't worry about it – I will still grade your exam.

The exam is worth 100 points. Each problem is worth 10 points. Please make your work coherent, complete, and correct. Please $\boxed{CIRCLE}$ your answer. Please **CHECK** your answer whenever possible.

No Calculators, Cell phones, computers, notes, etc.

(1) Find the the absolute maximum and the absolute minimum values of

$$f(x,y) = x^3 - xy + y^2 - x$$

on the region where $0 \le x$, $0 \le y$, and $x + y \le 2$.

(2) Find the equation of the plane through the points $(2,1,-1)$, $(0,-2,0)$, and $(1,-1,2)$.

(3) Find the point on the plane $3x + 4y + z = 1$ that is closest to $(1,0,1)$.

(4) Find parametric equations for the line of intersection of the planes $x + y - z = 1$ and $3x + 2y - z = 0$.

(5) Consider the set of points in 3-space which satisfy both of the following equations $x^2 + y^2 + z^2 = 25$ and $x^2 + y^2 = 1$. What is this set of points called? Describe the set of points. Draw the set of points.

(6) An object is moving in 3-space. Let $\overrightarrow{\boldsymbol{r}}(t) = x(t)\overrightarrow{\boldsymbol{i}} + y(t)\overrightarrow{\boldsymbol{j}} + z(t)\overrightarrow{\boldsymbol{k}}$ be the position vector of the object at time t. Suppose that $\overrightarrow{\boldsymbol{r}}''(t) = t\overrightarrow{\boldsymbol{i}} + t^2\overrightarrow{\boldsymbol{j}} + t^3\overrightarrow{\boldsymbol{k}}$, $\overrightarrow{\boldsymbol{r}}'(0) = \overrightarrow{\boldsymbol{i}} + 2\overrightarrow{\boldsymbol{j}} + 3\overrightarrow{\boldsymbol{k}}$, and $\overrightarrow{\boldsymbol{r}}(0) = -\overrightarrow{\boldsymbol{j}} + 2\overrightarrow{\boldsymbol{k}}$. Where is the object at time $t = 1$?

(7) Find the equation of the plane tangent to $z = x^2 + y^2$ at the point where $x = 1$ and $y = 3$.

(8) Compute $\int_{-1}^{1}\int_{0}^{\sqrt{1-x^2}} dy\,dx$.

(9) Find the volume of the solid in the first octant bounded by the coordinate planes, the plane $x = 3$, and the parabolic cylinder $z = 4 - y^2$.

(10) Evaluate $\int_C xydx + (x+y)dy$ along the curve $y = x^2$ from $(-1,1)$ to $(2,4)$.