Math 241 Exam 1 Spring 2015 **Justin Wyss-Gallifent**

Directions: Do not simplify unless indicated. No calculators are permitted. Show all work as appropriate for the methods taught in this course. Partial credit will be given for any work, words or ideas which are relevant to the problem.

Please put problem 1 on answer sheet 1

1. (a) For the vectors $\bar{a} = 2\,\hat{\imath} + 1\,\hat{\jmath} - 1\,\hat{k}$ and $\bar{b} = 3\,\hat{\imath} + 2\,\hat{\jmath} + 0\,\hat{k}$ find $\mathrm{Pr}_{\bar{a}}\bar{b}$. Simplify. [10 pts]

   (b) The center of a sphere is $(3, 5, -2)$ and the sphere contains the origin. Does the sphere also contain the point $(6, 7, 0)$? [10 pts]

Please put problem 2 on answer sheet 2

2. (a) Find the parametric equations of the line through $(1, 2, 3)$ and perpendicular to the plane $7x - 4y + 8z = 5$. [6 pts]

   (b) Find the point where the line with symmetric equation $\frac{x-1}{2} = y - 3 = \frac{z}{4}$ intersects the plane with equation $2x - y + z = 0$. [14 pts]

Please put problem 3 on answer sheet 3

3. (a) An object follows the path $\bar{r}(t) = t\,\hat{\imath} + t^2\,\hat{\jmath}$ for $t \geq 0$. Sketch the path of the object. When $t = 2$ indicate the object's position and find and sketch its velocity and acceleration vectors at that instant. (Attach those two vectors to the object). [10 pts]

   (b) Find the distance between the line $\bar{r}(t) = (-2t - 3)\,\hat{\imath} + (2t + 1)\,\hat{\jmath} + 3t\,\hat{k}$ and the origin. [10 pts]

Please put problem 4 on answer sheet 4

4. (a) Find a parametrization $\bar{r}(t)$ of the right half of the circle $x^2 + (y - 2)^2 = 9$ going from bottom to top. [8 pts]

   (b) Find the tangent and normal vectors at $t = \frac{\pi}{12}$ for the curve $\bar{r}(t) = \cos(2t)\ \hat{\imath} + \sin(2t)\ \hat{\jmath}$. If you're careful with your derivatives and trigonometry this should not be numerically complicated. Simplify! [12 pts]

Please put problem 5 on answer sheet 5

5. (a) Sketch the plane $2y + 3z = 12$. Mark at least three points with their coordinates. [6 pts]

   (b) Find the length of the curve parametrized by $\bar{r}(t) = 2\cos t\,\hat{\imath} + 2\sin t\,\hat{\jmath} + \frac{4}{3}t^{3/2}\,\hat{k}$ for $0 \leq t \leq 3$ and simplify! If you're careful this is an easy integral! [14 pts]

The End