**Math 241 Exam 1 Fall 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. Given the following data:

$$\bar{a} = 3\,\hat{\imath} - 2\,\hat{\jmath} + 1\,\hat{k}$$
$$\bar{b} = 1\,\hat{\imath} + 2\,\hat{\jmath} + 3\,\hat{k}$$

   (a) Show that $\bar{a}$ and $\bar{b}$ are not perpendicular. [3 pts]

   (b) Find a vector of length 1 perpendicular to both $\bar{a}$ and $\bar{b}$. [10 pts]

   (c) Find $\mathrm{Pr}_{\bar{b}}\bar{a}$. [7 pts]

---

**Please put problem 2 on answer sheet 2**

2. (a) Find the simplified equation of the plane containing $(1, 2, 3)$ and perpendicular to the line [8 pts]

$$\frac{x-2}{3} = \frac{5-y}{2},\ z = 3$$

   (b) Find the tangential component of acceleration $a_T$ at $t = 2$ for the curve parametrized by $\bar{r}(t) = t\,\hat{\imath} - t^2\,\hat{\jmath} + t^2\,\hat{k}$. [12 pts]

---

**Please put problem 3 on answer sheet 3**

3. (a) Sketch the VVF $\bar{r}(t) = 3\cos t\,\hat{\imath} + 2\,\hat{\jmath} + 2\sin t\,\hat{k}$ for $0 \le t \le \pi$. Label three points with their coordinates. [10 pts]

   (b) Write down a parametrization of the semicircle $x^2 + y^2 = 9$ with $x \ge 0$ along with the line segment joining the endpoints, in a counterclockwise direction. [10 pts]

---

**Please put problem 4 on answer sheet 4**

4. (a) Sketch the plane $2x + 12y + 3z = 24$ and label three points with their coordinates. [5 pts]

   (b) Sketch the plane $2x + 3y = 12$ and label two points with their coordinates. [5 pts]

   (c) Find the length of the curve parametrized by $\bar{r}(t) = \cos t\,\hat{\imath} + \sin t\,\hat{\jmath} + \frac{2}{3}t^{3/2}\,\hat{k}$ with $0 \le t \le 2$. If you're careful the integral should be easy. [10 pts]

---

**Please put problem 5 on answer sheet 5**

5. (a) Find the two points where the curve $\bar{r}(t) = t\,\hat{\imath} + t^2\,\hat{\jmath} - 3\,\hat{k}$ meets the plane $-2x + y + z = 0$. [10 pts]

   (b) Suppose $\bar{a}(t) = 1\,\hat{\imath} + 0\,\hat{\jmath} + 0\,\hat{k}$, $\bar{v}(0) = 0\,\hat{\imath} + 0\,\hat{\jmath} + 1\,\hat{k}$ and $\bar{r}(1) = \bar{0}$. Find $\bar{r}(t)$. [10 pts]

---

**The End**