Math 241 Exam 1 Sample 1

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:

$$P = (1, 0, 1)$$
$$Q = (4, -2, 0)$$
$$\bar{a} = 3\,\hat{\imath} + \hat{\jmath} - 2\,\hat{k}$$
$$\bar{b} = -3\,\hat{\imath} + 7\,\hat{\jmath} + \hat{k}$$

   (a) Find the vector $\overrightarrow{PQ}$. Simplify. [5 pts]
   (b) Find the magnitude of $\bar{b}$. Simplify. [5 pts]
   (c) Find the value of α so that $\alpha\,\hat{\imath} - 2\,\hat{\jmath} + \alpha\,\hat{k}$ is perpendicular to $\bar{a}$. Simplify. [5 pts]
   (d) Find $\mathrm{Pr}_{\bar{b}}\,\bar{a}$. Simplify. [5 pts]
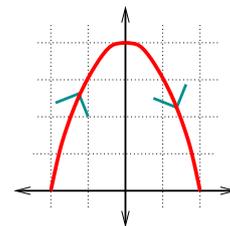
Please put problem 2 on answer sheet 2

2. (a) Find the distance between the point $(3, 2, 1)$ and the line with symmetric equations [12 pts]

$$\frac{x-2}{3} = \frac{y-1}{2} \quad , \qquad z = -2$$

   (b) Find the parametric equations for the line through the points $(2, -1, 4)$ and $(0, 1, 1)$. [8 pts]

Please put problem 3 on answer sheet 3

3. (a) Sketch the VVF $\bar{r}(t) = \cos t\,\hat{\imath} + \hat{\jmath} + \sin t\,\hat{k}$ for $0 \le t \le \pi$. Indicate direction. [6 pts]

   (b) Sketch the VVF $\bar{r}(t) = (1 + t)\,\hat{\imath} + (2 - 2t)\,\hat{\jmath} + 3\,\hat{k}$ for $0 \le t \le 2$. Indicate direction. [6 pts]

   (c) Give a parametrization of the oriented curve shown to the right. This curve is a parabola. [8 pts]

For part (c) only.

Please put problem 4 on answer sheet 4

4. (a) Given $\bar{r}(t) = 2t\,\hat{\imath} + t^2\,\hat{\jmath} + \frac{1}{3}t^3\,\hat{k}$, find $\bar{T}(t)$. [5 pts]

   (b) Calculate $\int\limits_0^1 2t\,\hat{\imath} + (t^2 - 1)\,\hat{\jmath} + e^{2t}\,\hat{k}\ dt$. Simplify. [5 pts]

   (c) Explain why the parametrization $\bar{r}(t) = (t^2 - 4t)\,\hat{\imath} + 5\,\hat{\jmath}$ for $0 \le t \le 3$ is piecewise smooth but not smooth. [10 pts]

Please put problem 5 on answer sheet 5

5. Find the point on the plane $2x - 4y + z = 10$ which is closest to the point $(1, 3, 0)$. There is more than one way to do this. Any remotely relevant pictures and/or calculations will be accepted for partial credit. [20 pts]

The End