## Math 20C (Shenk). Summer, 2011. Exam 1.

Name $\qquad$ Section

Work alone and use no books, notes, or calculators. Show your work with your answers on 8.5 " $\times 11$ " paper and staple the pages to the exam when you turn them in.
Problem 1 (10\%) Find the constant $k$ such that the vectors $\mathbf{A}=\langle-2,1,3\rangle$ and $\mathbf{B}=\langle-1,4, k\rangle$ are perpendicular.
Problem $2(10 \%)$ Find the angle $\theta(0 \leq \theta \leq \pi)$ between the vectors $\mathbf{C}=\langle 1,1,1\rangle$ and $\mathbf{D}=\langle 1,2,-2\rangle$.
Problem 3 (10\%) What is the vertex $R$ opposite $P$ in the parallelogram $P Q R S$ if $P=(1,1,1)$, $Q=(3,3,3)$ and $S=(-1,4,2)$ ?

Problem $4(10 \%)$ Give parametric equations of the line through $(3,1,2)$ and perpendicular to the plane $x-y+2 z=5$.

Problem 5 ( $10 \%$ ) Give parametric equations of the line through the points $P=(1,4,2)$ and $Q=(2,3,0)$.

Problem $6(10 \%)$ Give an equation of the plane through the points $O(0,0,0), P(2,0,3)$, and $Q(2,-1,1)$.
Problem 7 (10\%) The vertices of a tetrahedron are $O=(0,0,0), P=(1,2,3), Q=(0,1,5)$ and $R=(4,0,1)$. What is its volume?

Problem 8 ( $10 \%$ ) Draw the curve in an $x y$-plane with the parametric equations $C: x=x(t)$, $y=y(t), 0 \leq t \leq 4$, where the graphs of $x=x(t)$ and $y=y(t)$ are in Figures 1 and 2. Show the curve's orientation.


FIGURE 1


FIGURE 2


FIGURE 3

Problem 9 An object is at $x=t-t^{2}$ (miles), $y=t^{2}+t$ (miles) in an $x y$-plane at time $t$ (hours) for $-2.1 \leq t \leq 2.1$. Its path is in Figure 3.
(a) $(10 \%)$ Show that the object's speed is $\sqrt{2+8 t^{2}}$ miles per hour at time $t$.
(b) $(10 \%)$ Find the object's velocity vector at the point where its speed is a minimum and draw it with the curve. Use the scales on the coordinate axes to measure the components of the vector.

| Scores: <br> 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
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