

1. (10 pts) Find a vector equation for the line through the points $(0, 2, -1)$ and $(-2, 3, 2)$.
2. (10 pts) Find the angle between the vectors $\mathbf{u} = -2\mathbf{i} + \mathbf{j} - 2\mathbf{k}$ and $\mathbf{v} = -3\mathbf{i} + \mathbf{j} + \mathbf{k}$. Give your answer in degrees, rounded to the nearest degree.
3. (20 pts) A triangle has vertices at the three points

$$A = (1, 2, -3), \quad B = (-1, 0, 2), \quad \text{and} \quad C = (2, 1, -1).$$

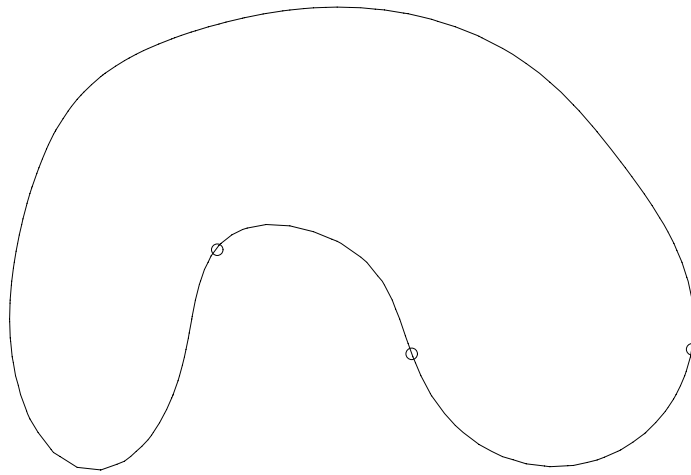
- (a) Find an equation for the plane containing the triangle.
- (b) Find the area of the triangle.

Problems 4 through 7 refer to the position function $\mathbf{r}(t) = \langle t - t^3, 2 + t^2, 4 - 2t \rangle$.

4. (10 pts) Find the velocity $\mathbf{v}(t)$.
5. (10 pts) Find the speed $v(t)$.
6. (10 pts) Find the acceleration $\mathbf{a}(t)$.
7. (10 pts) Find the curvature $\kappa(t)$.
8. (10 pts) Find the arclength of the curve $\mathbf{r}(t) = 3 \sin t^2 \mathbf{i} + 3 \cos t^2 \mathbf{j} - 2t^2 \mathbf{k}$ for $0 \leq t \leq 3$.

PROBLEM 9 IS ON THE BACK

9. (10pts) A car is driving around the track shown below at a constant speed, traveling in the clockwise direction. Draw plausible velocity and acceleration vectors for the car at the three marked points. Indicate clearly which are velocity vectors and which are acceleration vectors. If any of the vectors are 0, indicate this on the diagram.



DO NOT FORGET TO HAND IN THIS SHEET WITH YOUR EXAM!