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| Test 1Dusty Wilson Math 153 No work = no credit  No Symbolic Calculators | **Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  *I myself, a professional mathematician, on re-reading my own work find it strains my mental powers to recall to mind from the figures the meanings of the demonstrations, meanings which I myself originally put into the figures and the text from my mind. But when I attempt to remedy the obscurity of the material by putting in extra words, I see myself falling into the opposite fault of becoming chatty in something mathematical.*  Johannes Kepler (1597 - 1630)  German astronomer |

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| Warm-ups (1 pt each): | =\_\_\_\_\_ | =\_\_\_\_\_ | =\_\_\_\_\_ |

(1 pt) Based upon the quote above, how did easily did Kepler understand his earlier work? Answer using complete English sentences.

(12 pts) Consider points , , and .

1. Find the equation of the line that includes *A* and *B*.
2. Find the angle between  and . Express your answer in radians to 4 decimal places.
3. Find the equation of the plane that includes the three points.

(12 pts) Consider the line  and the point .

1. Find the plane that includes point *A* that is perpendicular to the line.
2. Find the point *B* where the line intersects the plane found in (a.).
3. Find the distance from point *A* to the line.

(12 pts) Consider the parametric curve  and  for .

1. Compute the length of the curve on 
2. Convert this parametric equation into an equation of the form  and compute the length of the graph of  on .
3. Is the answer in part (a.) the same as the answer in part (b.)? How do you explain this result?

Consider the limaçon .

1. (8 pts) Find the second quadrant point where the tangent is vertical.
2. Set up (do not solve) an integral that represents the area inside the smaller loop of the limaçon.

(20 pts) A point moves with position vector given by .

1. Find and 
2. Find the unit tangent vector  for 
3. Find the unit normal vector  for 
4. Find the curvature of 
5. Find the tangential and normal components of the acceleration vector