Problem Session – Green January 18, 2006

Do the following problems on a separate sheet of paper and hand in at the end of the period (there is nothing to do on the first 2 problems).

1. Maple commands for plotting a function in 3-dimensions of the form $z = f(x,y)$ where $x$ ranges between $a$ and $b$ and $y$ ranges between $c$ and $d$ is
   
   - with(plots):
   - plot3d($f(x,y), x = a .. b, y = c .. d$);

   Use the plot3d command to plot the surface given by the equation $z = x^2 - y^2$. Let $x$ and $y$ both range between –5 and 5. Click on the picture while still holding down the button and move the mouse to rotate the picture. This surface is a type of “saddle”. Giddy up!!

2. Maple commands for plotting an equation in 3-dimensions of the form $f(x,y,z) = 0$ where $x$ ranges between $a$ and $b$, $y$ ranges between $c$ and $d$, and $z$ ranges between $e$ and $f$ is
   
   - with(plots):
   - implicitplot3d($f(x,y,z) = 0, x = a .. b, y = c .. d, z = e .. f$);

   where you put in your given equation for $f(x,y,z) = 0$. Use Maple to plot the sphere $x^2 + y^2 + z^2 = 9$ where $x$, $y$, and $z$ all range between –3 and 3. If you click on the 1-1 button, all axes will be equally spaced so it will look like a sphere. Move it around.

3. To plot a parametric curve $x = x(t), y = y(t), a \leq t \leq b$ in Maple, the command is
   
   - plot([$x(t), y(t), t = a .. b$]);

   Let $C$ be the curve described by the parametric equations $x = t^2 - 4$ and $y = \frac{t}{2}$, $-2 \leq t \leq 3$.
   
   a. Eliminate the variable $t$ to find a relationship between $x$ and $y$.
   
   b. Write the Maple command to plot $C$. Use Maple to plot the curve and draw a sketch of the curve from Maple.

4. Convert the polar equation $r = 3\csc \theta$ to rectangular form.

   To plot a polar equation $r = f(\theta)$, $a \leq \theta \leq b$ in Maple, the command is
   
   - polarplot($f(t), t = a \ldots b$); (we use $t$ because it is easier to type in Maple than $\theta$).

   Write the Maple command to plot the polar equation above. Plot it in Maple to check your answer.

4. Convert the equation $y^2 = 9x$ to polar form and simplify.
5. Let $r = 2 + 3\sin\theta$.
   a. Fill in the following table of values

<table>
<thead>
<tr>
<th>$\theta$</th>
<th>0</th>
<th>$\pi/4$</th>
<th>$\pi/2$</th>
<th>$3\pi/4$</th>
<th>$\pi$</th>
<th>$5\pi/4$</th>
<th>$3\pi/2$</th>
<th>$7\pi/4$</th>
<th>$2\pi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. Use Maple to plot the curve between 0 and $2\pi$. Find your points in the table above on the curve.

6. Let $\vec{u} = (5,1)$ and $\vec{v} = (-1,2)$.
   a. Graph $\vec{u}, \vec{v}, \vec{u} + \vec{v}$, and $\vec{u} - \vec{v}$ on the same graph.
   b. Find $|\vec{u}|$ and find a unit vector in the direction of $\vec{u}$. (You can find it in the book).