1. Find area of:

(i) one loop of the graph of \( r = 3 \cos 5\theta \).

(ii) the region inside the circle \( r = 1 \) and outside the cardioid \( r = 1 - \cos \theta \).

2. On the cardioid \( r = 1 + \sin \theta \), find points where tangent line is vertical.

3. Include all details to sketch the graph of \( r^2 = 4 \cos \theta \).

4. Calculate area of the surface generated by revolving the graph of \( r^2 = 2 \cos 2\theta \) about the polar axis where \( 0 \leq \theta \leq \pi \).

5. (i) Two spheres \( S_1 \) and \( S_2 \) are centered at the origin and are tangent to the sphere of radius 1 centered at \( (5, -2, 3) \). Write equations of \( S_1 \) and \( S_2 \).

(ii) Find 2 unit vectors that are perpendicular to the line \( y = -3x + 1 \).

6. (i) Do the vectors

\[
\vec{U} = \langle 1, -2, 1 \rangle \\
\vec{V} = \langle 3, 0, -2 \rangle \\
\vec{W} = \langle 5, -4, 0 \rangle
\]

lie in the same plane? Justify.
(ii) Show that \( \| \vec{U} \times \vec{V} \|^2 = \| \vec{U} \|^2 \| \vec{V} \|^2 - (\vec{U} \cdot \vec{V})^2 \) 

7. Check whether the lines are parallel or skew lines:
\[ L_1 : \quad x = 1 + t, \quad y = -2 + 3t, \quad z = 4 - t \]
\[ L_2 : \quad x = 2t, \quad y = 3 + t, \quad z = -3 + 4t \]

8. Find the distance between lines.
\[ L_1 : \quad x = 2t, \quad y = 3 + 4t, \quad z = 2 - 6t \]
\[ L_2 : \quad x = 1 + 3t, \quad y = 6t, \quad z = -9t \]