Name:______________________________

1. Find the exact length of the curve $r = \cos^3\left(\dfrac{\theta}{3}\right)$ on the interval $0 \le \theta \le \pi$.

2. Find the exact length of the curve $r = 2 + 2\cos\theta$ on the interval $0 \le \theta \le \pi$.

3. Find the scalar and vector projections of $\mathbf{b}$ onto $\mathbf{a}$ where $\mathbf{a} = \langle 1, 7, 5 \rangle$ and $\mathbf{b} = \langle 8, 2, 3 \rangle$.

4. Find the scalar and vector projections of $\mathbf{b}$ onto $\mathbf{a}$ where $\mathbf{a} = \langle 1, 1, 3 \rangle$ and $\mathbf{b} = \langle -5, -2, 4 \rangle$.

5. Find the cosine of the angle between the vectors $\mathbf{a} = \langle 3, 5, 1 \rangle$ and $\mathbf{b} = \langle 8, -4, 6 \rangle$.

6. Find the cosine of the angle between the vectors $\mathbf{a} = \langle 7, 6, 4 \rangle$ and $\mathbf{b} = \langle 9, 1, 3 \rangle$.

7. Find the cross product of $\mathbf{a} = \langle t, \sin t, 1/t \rangle$ and $\mathbf{b} = \langle t^2, \cos t, 1 \rangle$.

8. Find the cross product of $\mathbf{a} = \langle t, t^2, t^3 \rangle$ and $\mathbf{b} = \langle 1, 2t, 3t^2 \rangle$.

9. Find a vector equation and parametric equations of the line that passes through the points $P = (1, 1, 2)$ and $Q = (3, -2, 3)$.

10. Find a vector equation and parametric equations of the line that passes through the points $P = (-5, 3, 4)$ and $Q = (-3, -2, 1)$.

11. Find an equation of the plane containing the points $P = (5, 1, 4)$, $Q = (-1, 3, 4)$, and $R = (1, 1, 1)$.

12. Find an equation of the plane containing the points $P = (1, 0, 2)$, $Q = (3, 2, 5)$, and $R = (8, 1, 0)$.

13. Classify the surface by writing it in the standard form: $4y^2 + z^2 - x - 16y - 4z + 20 = 0$.

14. Classify the surface by writing it in the standard form: $x^2 - y^2 + z^2 - 2x + 2y + 4z + 2 = 0$.

15. Show the following inequality, $\|\mathbf{a}+\mathbf{b}\| \leq \|\mathbf{a}\| + \|\mathbf{b}\|$. This is known as the triangle inequality. You will need to use the following $\|\mathbf{a}\cdot\mathbf{b}\| \leq \|\mathbf{a}\|\|\mathbf{b}\|$.