

Name: _____

1. Consider the vector function

$$\mathbf{r}(t) = 3t\mathbf{i} + 4\sin t\mathbf{j} + 4\cos t\mathbf{k}.$$

(a) Find the domain. Put a box around your answer.

8 pts

(b) Sketch the space curve with the given vector equation. Indicate with an arrow the direction in which t increases.

10 pts

(c) Reparametrize the curve with respect to arclength measured from the point where $t = 0$ in the direction of increasing t .

10 pts

(d) State a *formula for curvature that uses the result of Problem (1c)*. **Do not calculate the curvature.**

8 pts

(OVER)

2. A projectile is fired from the ground with an initial speed of 500 m/s and angle of elevation 60 degrees. Assume that the only external force is due to gravity. (Air resistance is negligible.) Then the acceleration function is $\mathbf{a}(t) = -g\mathbf{j}$, where $g \approx 9.8 \text{ m/s}^2$. Use calculus to find the position function $\mathbf{r}(t)$ of the projectile.

10 pts

3. Given $\rho = \sqrt{x^2 + y^2 + z^2}$, calculate $\frac{\partial^2 \rho}{\partial x^2}$.

10 pts

4. Consider the function $f(x, y, z) = \ln(25 - x^2 - y^2 - z^2)$.

(a) State the domain of the function. Put a box around your answer.

6 pts

(b) Sketch the domain of the function.

6 pts

5. Find an equation of the tangent plane to the surface $z = e^{x^2 - y^2}$ at the point $(1, -1, 1)$.

10 pts

6. Consider $f(x, y) = y^2/x$.

(a) Find the maximum rate of change of the function at the point $(2, 4)$.

6 pts

(b) In what direction does the maximum rate of change of the function occur at the point $(2, 4)$?

6 pts

7. Use a tree diagram to write the chain rule for $\frac{\partial w}{\partial u}$ if $w = f(x, y, z)$, $x = x(t, u)$, $y = y(t, u)$, $z = z(t, u)$.

10 pts