Your Name


Student ID \#


Professor's Name
$\square$

Your Signature
$\square$


TA's Name


- This exam is closed book. You may use one $8 \frac{1}{2} \times 11$ sheet of handwritten notes (both sides may be used).
- Graphing calculators are not allowed. Do not share notes.
- In order to receive credit, you must show your work. Do not do computations in your head. Instead, write them out on the exam paper.
- Place a box around YOUR FINAL ANSWER to each question.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so.
- Raise your hand if you have a question.

| Problem | Total Points | Score |
| :---: | :---: | :---: |
| 1 | 10 |  |
| 2 | 10 |  |
| 3 | 10 |  |
| 4 | 10 |  |
| 5 | 10 |  |


| Problem | Total Points | Score |
| :---: | :---: | :---: |
| 6 | 10 |  |
| 7 | 10 |  |
| 8 | 10 |  |
| 9 | 10 |  |
| 10 | 10 |  |
| Total | 100 |  |

1. [10 points] Find the Taylor polynomial of degree 2 centered at $x=-1$ for the function $f(x)=x^{3}+2 x+4 \cos (\pi x)$.
2. [10 points] Use Taylor's inequality to find $n$ such that the Taylor polynomial of degree $n$ centered at $x=0$ for the function $g(x)=e^{2 x}$ approximates $g(x)$ with accuracy 0.01 on the interval $[-.5,0]$.
3. [ $\mathbf{1 0}$ points] Find the equation of the line of intersection of the two planes given by $x+2 y+3 z=0$ and $x-y=3$.
4. [10 points] Two elementary particles are on a collision course (that is, at some instant of time, they will be at the same location). The position of one of them is given by

$$
x=2 \sin t, y=2 \cos t,
$$

the position of the other one is

$$
x=3-4 \sin t, y=2 \cos t
$$

for time $t \geq 0$. Find the cosine of the angle between the velocity vectors of the two particles at the instant the particles collide.
5. [10 points] While driving your car on a highway, you travel at a constant speed of $100 \pm 2$ $\mathrm{km} /$ hour for $40 \pm 1$ seconds. Use differentials to estimate the uncertainty in the distance you travelled in these 40 seconds.
6. [10 points] A sheet of material covering the first quadrant $(x \geq 0, y \geq 0)$ has a surface density (mass per area) given by

$$
\rho(x, y)=6 e^{-2 x-3 y}
$$

What is the total mass of that part of the sheet enclosed by the triangular area whose vertices are located at $(1,0),(0,0),(0,1)$ ?
7. [10 points] Evaluate the integral

$$
I=\int_{0}^{1} \int_{\sqrt{y}}^{1} \sqrt{x^{3}+1} d x d y
$$

8. [10 points] Consider the surface

$$
x^{2}+y^{2}+z^{2}=1
$$

and let $(a, b, c)$ be some point on the surface. Find an equation for the plane tangent to this surface at $(a, b, c)$. Simplify your answer as much as possible.
9. [10 points] Suppose the trajectory of a particle is given by

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

Calculate the magnitude of the normal component of the acceleration experienced by the particle at $t=1$.
10. [10 points] Consider the parametric curve given, for $t \geq 0$, by

$$
\mathbf{r}(t)=\left\langle\cos t^{2}, \sin t^{2}, \frac{\sqrt{5}}{2} t^{2}\right\rangle
$$

(a) Reparameterize the curve using arc length measured from the point $(1,0,0)$.
(b) Find the curvature of the curve.

