

Your Name

Your Signature

Student ID #

Quiz Section

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Professor's Name

TA's Name

- CHECK that your exam contains 8 problems on 6 double-sided pages, including this cover sheet. There is one blank page at the front and two blank pages at the back reserved for scratch work or extra space.
- This exam is closed book. You may use one $8\frac{1}{2}'' \times 11''$ sheet of notes and a TI-30X IIS calculator. Do not share notes or calculators.
- Unless otherwise specified, you should give your answers in exact form. (For example, $\frac{\pi}{4}$ and $\sqrt{2}$ are in exact form and are preferable to their decimal approximations.)
- In order to receive full credit, you must show all of your work.
- Place a box around **YOUR FINAL ANSWER** to each question.
- If you need more room, use the back of the first page or either side of the last page **and indicate that you have done so**. If you *still* need more room, ask for more scratch paper.
- Do not write within 1 centimeter of the edge of the page.
- Raise your hand if you have a question.

Problem	Total Points	Score
1	12	
2	12	
3	12	
4	12	
5	14	

Problem	Total Points	Score
6	12	
7	12	
8	14	
Total	100	

You may use this page for scratch-work.

All work on this page will be ignored unless you write & circle “see first page” below a problem.

1. (12 points) Let $\mathcal{P}$ be the plane given by the equation

$$-x + y + z = 2.$$

The point $Q(2, 1, -1)$ is not on the plane $\mathcal{P}$. Let L_1 be the line through Q and orthogonal to $\mathcal{P}$, and let R be the point of intersection of L_1 and $\mathcal{P}$. Let W be another point $(-1, 3, 1)$.

Find parametric equations of the line L_2 that passes through points W and R .

12.5

Parametric equations: _____

2. (6 points per part) **Parts (a) and (b) of this question are unrelated.**

- (a) Find the equation for the quadric surface consisting of all points that are equidistant to the plane $y = 3$ and the point $(0, 1, 2)$. Then identify the quadric surface. (a) 12.6

Equation for surface: _____

Name of surface: _____

(b) 13.3

- (b) Let P be the point where $\mathbf{r}(t) = \langle t^2 + t, t^3, \frac{-3}{2}t^2 - 2t \rangle$ intersects the plane $y = -8$. Find the curvature of $\mathbf{r}(t)$ at P .

Curvature: _____

3. (12 points) Find the equation of the plane tangent to the surface

$$z = x^2y - \sqrt{3x - y} - \frac{x}{y}$$

14.4

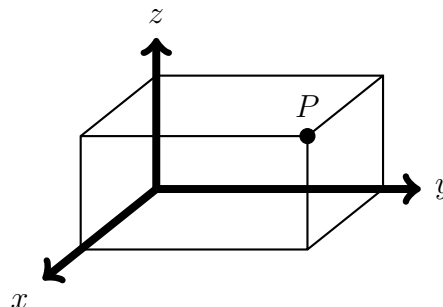
at the point $(6, 2, 65)$. **Write your answer in the form** $Ax + By + Cz = D$.

Tangent plane equation: _____

4. (12 points) Find the volume of the largest rectangular box in the first octant with three faces in the coordinate planes and the vertex opposite the origin (i.e. the one marked P in the picture below) on the surface $z = 20 - x^2 - y$.

14.7

In order to receive full credit, you must show that your answer really is the maximum.



Maximum volume: _____

5. (7 points per part) Part (a) and (b) of this question are not related.

(a) Compute $\int_1^5 \int_{\sqrt{y-1}}^2 \frac{x^2}{1+x^5} dx dy$ (Hint: reverse the order of integration)

Answer = _____

(b) Set up (but **do not evaluate**) an integral for the volume of the solid enclosed by the cylinder $y = x^2$ and the planes $y + z = 4$ and $z = 0$.

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Chapter 15 material · covered in Math 224

Volume = $\int \int \int d\mathbf{r} d\mathbf{r}' d\mathbf{r}''$

6. (6 points per part) A lamina D occupies the region **in the first quadrant** that lies inside the circle $x^2 + y^2 = 4$ and outside the circle $x^2 + (y - 2)^2 = 4$.

The density at any point is $\rho(x, y) = \frac{x}{\sqrt{x^2 + y^2}}$.

- (a) Find the mass of D .

(Hint: Set up and evaluate a double integral in polar coordinates.)

Mass = _____

- (b) Find $\bar{y}$, which is the y -coordinate of the center of mass.

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Chapter 15 material · covered in Math 224

$\bar{y} =$ _____

7. (6 points per part) Let $f(x) = \sin(x - 1) + x^2 + e^x$.

(a) Find the second Taylor polynomial $T_2(x)$ for f based at $b = 1$.

11.11

$$T_2(x) = \underline{\hspace{4cm}}$$

(b) Find an upper bound for $|f(x) - T_2(x)|$ on the interval $\left[\frac{1}{2}, \frac{3}{2}\right]$.

In order to receive credit, you must justify your answer.

Taylor-series emphasis changed in Autumn 2026.

Use current homework as your primary study guide.

$$\text{Upper bound} = \underline{\hspace{4cm}}$$

8. For this problem, you may use the following basic Taylor series:

$$\frac{1}{1-x} = \sum_{k=0}^{\infty} x^k, \quad e^x = \sum_{k=0}^{\infty} \frac{x^k}{k!}, \quad \sin x = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k+1}}{(2k+1)!}, \quad \cos x = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k}}{(2k)!} \quad 11.10.11.11$$

- (a) (6 points) Use the list of Basic Series to find the Taylor series for $f(x) = x^2 \arctan(-3x)$ based at $b = 0$. (Use Σ notation.)

Taylor series: _____

- (b) (3 points) Find the open interval on which the series in part (a) converges.

Interval of convergence: _____

- (c) (5 points) Find $f^{2023}(0)$. (That is, the 2023th derivative of f at 0.) Give an exact answer.

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$f^{(2023)}(0) =$ _____

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