Your Name

Your Signature

Student ID #

Quiz Section

Professor's Name (check one)

Charles Camacho ☐ Andy Loveless ☐ Jonah Ostroff ☐

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.
- **Write your answers in the provided blanks.**
- 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.**
- **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	10	
2	12	
3	12	
4	13	
5	12	

Problem	Total Points	Score
6	13	
7	14	
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. *(2 points each)* Each of the following multiple choice problems has one correct answer. Circle it. You do not need to show any reasoning.

   (a) What is the radius of the sphere through $(-1, 2, 0)$ with center $(0, 0, 2)$?

   (i) $\sqrt{2}$ (ii) 3 (iii) 4 (iv) $\sqrt{5}$

   (b) If $\mathbf{proj_a b} = \langle 1, 2, 3\rangle$, what's $\mathbf{proj}_{\langle 2,4,6\rangle}\mathbf{b}$?

   (i) $\langle 1, 2, 3\rangle$ (ii) $\langle 2, 4, 6\rangle$ (iii) $\langle 3, 6, 9\rangle$ (iv) $\langle \sqrt{2}, 2\sqrt{2}, 3\sqrt{2}\rangle$

   (c) If $\mathbf{a}$ and $\mathbf{b}$ are unit vectors, which of the following **cannot** equal $\mathbf{a} \times \mathbf{b}$?

   (i) $\langle 0, 0, 0\rangle$ (ii) $\langle 0, 1, 0\rangle$ (iii) $\langle 1, 0, 1\rangle$ (iv) $\langle \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\rangle$

   (d) Which point lies on the line through $(1, 2, 3)$ and $(2, 0, 1)$?

   (i) $(-1, 5, 7)$ (ii) $(0, 4, 5)$ (iii) $(2, 1, 2)$ (iv) $(3, -2, 5)$

   (e) Which of the following planes is parallel to the line $\mathbf{r}(t) = \langle t, 2t, 3t\rangle$?

   (i) $x + y + z = 6$ (ii) $x + 2y + 3z = 1$ (iii) $2x - y + z = 4$ (iv) $x + y - z = 7$

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

   (a) Find an equation for the surface consisting of all points (x, y, z) such that the distance from (x, y, z) to the x-axis is equal to the distance from (x, y, z) to the point $(0, 0, 2)$, **and** give a precise name for the corresponding 3D surface.

   Equation: ______________________________

   Name: ______________________________

   (b) Find a vector function $\mathbf{r}(t)$ whose space curve is the curve of intersection of the cylinder $y^2 + z^2 = 1$ and the hyperbolic paraboloid $x - y^2 + z^2 = 2$.

   $\mathbf{r}(t) =$ ______________________________

3. *(6 points per part)* For parts (a) and (b), let $\mathcal{S}$ be the surface $z = \dfrac{y}{x} + \sqrt{y - 2x}$.

   (a) Find the equation of the plane tangent to $\mathcal{S}$ at $(2, 8, 6)$.

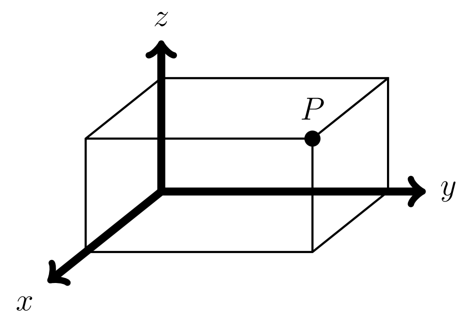
   Plane equation: ______________________________

   (b) Use linearization to estimate the x-coordinate of the point $(x, 7.98, 5.91)$ on $\mathcal{S}$.

   $x \approx$ ____________________

4. *(13 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 $2x^2 + y + z = 90$.

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



Maximum volume: ____________________

5. *(12 points)* Set up, but **do not evaluate**, an iterated integral using polar coordinates equal to the volume between the paraboloids $z = -2x + 3x^2 + 3y^2$ and $z = 2x^2 + 2y^2$.

Integral: ____________________________________

6. *(13 points)* Find the center of mass of the lamina that occupies the quarter disk **in the first quadrant** bounded by $x^2 + y^2 = 4$ with density function $\rho(x, y) = 1 + x^2 + y^2$.

$(\overline{x}, \overline{y}) =$ ______________________________

7. *(14 points)* Let $g(x) = \dfrac{1}{2}\ln(2x-3)$.

   In this problem you will find the Taylor polynomial based at $b = 2$ (**NOT** at $b = 0$).

   (a) Find the third Taylor polynomial, $T_3(x)$, for the function g based at $b = 2$.

   $T_3(x) =$ ______________________________

   (b) Use Taylor's inequality to find an upper bound (as sharp as possible) for $|f(x) - T_3(x)|$ on the interval $[1.8, 2.2]$.

   Upper bound: ________________________

8. *(14 points)* Let $f(x) = x\sin(2x^3)$.

   (a) Find the Taylor series for $f(x)$ based at 0.

   Simplify your final answer and write it in sigma notation.

   Taylor series: ____________________

   (b) Find $f^{(16)}(0)$.

   $f^{(16)}(0) =$ ____________________

   (c) Give the first two nonzero terms of the Taylor series for $g(t) = \int_0^t x\sin(2x^3)\,dx$.

   First two nonzero terms: ____________________

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