Name: ____________________

- **READ THE FOLLOWING DIRECTIONS!**
- **Do NOT open the exam until instructed to do so.**
- You have 75 minutes to complete this exam. When you are told to stop writing, do it or you will lose all points on the page you write on.
- You may not communicate with other students during this test.
- No written materials of any kind are allowed. No scratch paper is allowed except as given by the proctors.
- No phones, calculators, or any other electronic devices are allowed for any reason, including checking the time (a simple wristwatch is fine).
- Any case of cheating will be taken extremely seriously.
- Show all your work and explain your answers.
- Before turning in your exam, check to make certain you've answered all the questions.

You may or may not need the following formulas:

$$\sin^2 t = \frac{1}{2}(1 - \cos(2t))$$
$$\cos^2 t = \frac{1}{2}(1 + \cos(2t))$$

Question:	1	2	3	4	5	6	7	8	Total
Points:	10	6	8	2	7	10	6	3	52
Score:									

1. (10 points) Find the volume of the region bounded by $z = y$, $x = y^2$, $x = 1$, and $z = 1$.

2. A metal sheet occupies the rectangle $[0,7]\times[0,9]$. It has non-uniform density; you are given the densities at various points:

y \ x	0	1	2	3	4	5	6	7
9	1	2	4	6	5	3	1	2
8	0	1	3	4	5	3	2	1
7	5	3	5	7	6	4	2	1
6	2	4	5	6	7	4	3	2
5	3	5	6	8	9	6	5	3
4	1	4	6	7	9	6	4	3
3	2	3	4	6	7	5	4	3
2	4	5	3	4	5	3	2	1
1	5	6	4	3	3	1	1	2
0	6	8	7	4	2	1	2	3

$\rho(x,y)$

(a) (3 points) Estimate the mass of the part of the sheet R with $1 \le x \le 5$ and $4 \le y \le 8$, using a Riemann sum with two subintervals in each direction (the book/WebAssign would say $m = n = 2$).

(b) (3 points) Estimate $\iint_R x\rho(x,y)\,dA$, using again a Riemann sum with two subintervals in each direction.

3. (8 points) Set up the integral in spherical coordinates (*you do not have to evaluate it*):

$$\int_0^3 \int_{-\sqrt{9-y^2}}^{\sqrt{9-y^2}} \int_0^{\sqrt{9-x^2-y^2}} \sqrt{x^2+y^2}\, dz\, dx\, dy$$

4. (2 points) Circle 'True' or 'False' (1 point each):

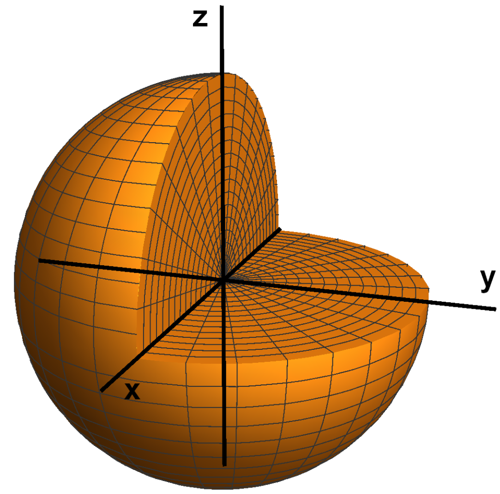
(a) True False For any two functions f, g of three variables and any region E,
$\iiint_E (f+g)\ dV = \iiint_E f\ dV + \iiint_E g\ dV.$

(b) True False For any two functions $f(x, y)$ and $g(z)$ and any region E, if I is the shadow of E on the z-axis and D the shadow in the xy-plane, then
$\iiint_E f(x,y)g(z)\ dV = \left(\iint_D f(x,y)\ dA\right)\left(\int_I g(z)\ dz\right)$

5. (7 points) Evaluate $\displaystyle\iint_R \frac{3x-y}{x+3y}\,dA$, where R is the parallelogram enclosed by the lines $3x-y=2$, $3x-y=4$, $x+3y=5$, and $x+3y=7$.

6. (10 points) Compute $\int_1^6 \int_0^{\ln x} y \, dy \, dx$ by changing the order of integration.

7. (6 points) Below is a region E. For each part, circle the sign of the integral and give brief justification:

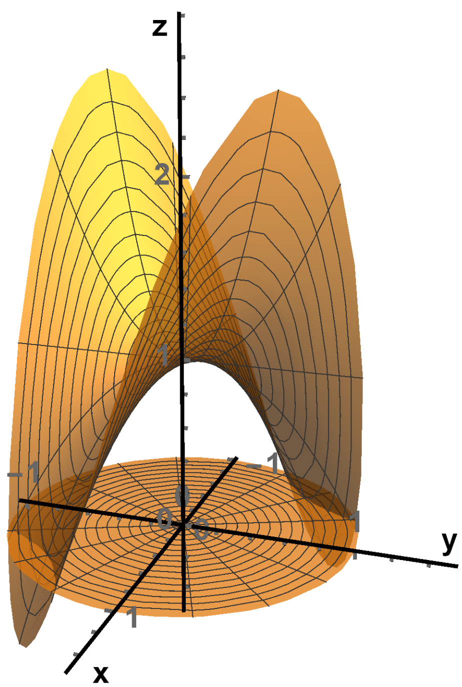


$\iiint_E xy\ dV$ + 0 −

$\iiint_E y\ dV$ + 0 −

$\iiint_E \left(z + \frac{1}{2}\right) dV$ + 0 −

8. (3 points) Below is shown the graph of a function f over the unit disk R in the xy-plane. Estimate the average value of f on R.



Scratch Paper - Do Not Remove

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