

Mechanics Based Problems

1. For the following iterated integrals, sketch the region of integration, label all curves and points of intersection, and evaluate the iterated integral:

(a) $\int \int_D x^3 y^2 dA$, where $D = \{(x, y) | 0 \leq x \leq 2, -x \leq y \leq x\}$

-12.1905 ANS

(b) $\int \int_D x \cos(y) dA$, where D is bounded by $y = 0, y = x^2, x = 1$

0.23 ANS

(c) $\iint_D y^3 dA$, where D is bounded by the triangular region with vertices $(0, 2), (1, 1), (3, 2)$

3.1

Problem Solving Problems

1. Find the volume of the solid under the paraboloid $z = x^2 + y^2$ and above the region bounded by $y = x^2$ and $x = y^2$.

0.17

2. Use Mathematica to estimate the x-coordinates of the points of intersection of the curves $y = x^4$ and $y = 3x - x^2$.
If D is the region bounded by these curves calculate: $\iint_D x dA$

0.71

3. Use Mathematica to find the volume of the solid between the paraboloids $z = 2x^2 + y^2$ and $z = 8 - x^2 - 2y^2$ and inside the cylinder $x^2 + y^2 = 1$

20.42

4. Sketch the region of integration and change the order of integration for: $\int_1^2 \int_0^{\ln x} f(x, y) dy dx$

$$\int_0^{\ln(2)} \int_{e^y}^2 f(x, y) dx dy$$

5. In evaluating a iterated integral over a region D , a sum of iterated integrals was obtained as follows:

$$\iint_D f(x, y) dA = \int_0^1 \int_0^{2y} f(x, y) dx dy + \int_1^3 \int_0^{3-y} f(x, y) dx dy$$

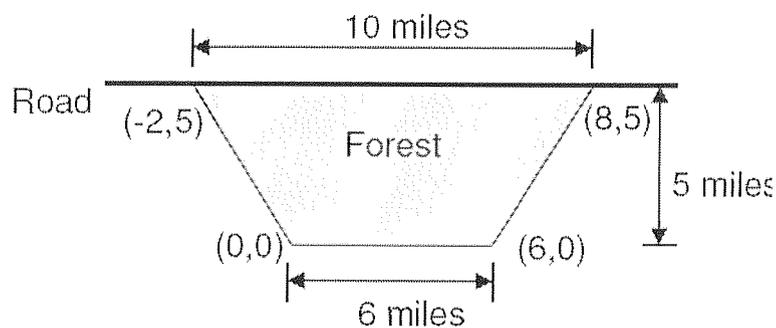
Sketch the region D and express the iterated integral as a single iterated integral by reversing the order of integration.

$$\int_0^2 \int_{x/2}^{3-x} f(x, y) dy dx$$

6. A town is constructed in such a way as to radiate outwards from the town hall. Its major roads are concentric circles, cross roads which are perpendicular to the main roads, allow traffic to move towards or away from the town hall. If the town hall is placed at the point $(0, 0)$ then the price of land can be approximated by $P(x, y) = 200 - 10(x - \frac{1}{2})^2 - 15(y - 1)^2$ where $P(x, y)$ is the price of land at the point (x, y) in dollars per square foot and x and y are measured in miles. What is the average price of land per square foot for this town if the outer main road is at a radial distance of 2 miles from the town hall?

\$ 157.5

7. A forest next to a road has the shape shown. The population density of rabbits is proportional to the distance from the road. It is 0 at the road, and 10 rabbits per square mile at the opposite edge of the forest. Find the total rabbit population in the forest.



183.33 rabbits