

100 Points

Show **ALL** your work.

1. SET UP BUT DO NOT EVALUATE the integral(s) needed to find the surface area of  $z = 4 + x^2 + y^2$  that lies under  $z = 13$ .

10 Points

2. Evaluate  $\int_0^1 \int_{x^2}^1 4x \sin(y^2) \, dy \, dx$ .

12 Points

22 Points

3. SET UP BUT DO NOT EVALUATE a triple integral to find the volume of the region bounded by  $x = 0$ ,  $y = 0$ ,  $z = 0$ , and  $x + y + z = 3$ .

10 Points

4. Evaluate  $\iint_R 3y \, dA$  where  $R$  is the region in the first quadrant bounded by  $y = 0$ ,  $y = x$ ,  $x^2 + y^2 = 1$ , and  $x^2 + y^2 = 4$ .

12 Points

22 Points

5. SET UP BUT DO NOT EVALUATE integrals to find the  $y$ -coordinate of the center of mass of the solid bounded by  $z = 1 - y^2$ ,  $x = 0$ ,  $y = 0$ ,  $z = 0$ , and  $x + z = 1$ , if the density is given by  $\rho = x$ .

12 Points

6. Evaluate  $\int_0^1 \int_x^{2x} \int_0^{x+y} 6xy \, dz dy dx$ .

12 Points

24 Points

7. A solid  $Q$  is bounded above by  $x^2 + y^2 + z^2 = 4$  and bounded below by  $z = \sqrt{x^2 + y^2}$ .

Consider the integral  $\iiint_Q e^{-(x^2 + y^2 + z^2)} dV$ . SET UP BUT DO NOT EVALUATE

equivalent expressions for this integral in cylindrical and spherical coordinates.

- a) Cylindrical

10 Points

- b) Spherical

10 Points

8. SET UP BUT DO NOT EVALUATE an integral equivalent to  $\iint_R \cos\left(\frac{y-x}{y+x}\right) dA$ ,

where  $R$  is the region bounded by  $x = 1$ ,  $y = 0$ ,  $x - y = 2$ , and  $x - y = 3$ , by using the transformation  $u = x + y$ , and  $v = x - y$ .

12 Points

32 Points