1. Find the volume of the region bounded above by the surface $z = 2\sin x \cos y$ and below by the rectanble $R: \ 0 \le x \le \frac{\pi}{2}, \ 0 \le y \le \frac{\pi}{4}$.

2. Double integrate $f(s,t) = e^s \ln t$ over the region in the first quadrant of the $st-$plane that lies above the curve $s = \ln t$ from $t = 1$ to $t = 2$.

3. Sketch the region of integration and write an equivalent double integral with the order of integration reversed.

    (i) $\qquad \displaystyle\int_0^1 \int_1^{e^x} dy dx$

    (ii) $\qquad \displaystyle\int_0^2 \int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}} 6x dy dx$

    (ii) $\qquad \displaystyle\int_1^e \int_0^{\ln x} xy dy dx$

    (iii) $\qquad \displaystyle\int_0^{\sqrt{3}} \int_0^{\tan^{-1} y} \sqrt{xy} dx dy$

4. Sketch the region. Then change the order of integration and evaluate the new integral

    $$\int_0^3 \int_{\sqrt{\frac{x}{3}}}^1 e^{y^3} dy dx.$$

    Observe that if you directly evaluate the integral without changing the order of integration then it is very difficult to evaluate. So sometimes changing the order of integration makes our task much easier.

5. Find the volume of the solid in the first octant bounded by the coordinate planes, the cylinder $x^2 + y^2 = 4$ and the plane $z + y = 3$.

6. Find the average value of $f(x,y) = x\cos xy$ over the rectangle $R: \ 0 \le x \le \pi, \ 0 \le y \le 1$. (Hint: Average value of f over R equals

    $$\frac{1}{\text{area of } R} \iint_R f(x,y) dA.)$$

7. Find the volume (using triple integral) of the region between the cylinder $z = y^2$ and the $xy-$plane that is bounded by the planes $x = 0$, $x = 1$, $y = -1$ and $y = 1$.