

<http://timmel.chem.ox.ac.uk/lectures/>

**Integration**

1. Evaluate the following integrals:

$$\int_0^a \int_0^x \sqrt{a-x^2} dy dx$$

$$\int_0^4 \int_4^{12} xy dy dx$$

$$\int_{\phi=0}^{\pi/4} \int_{r=a}^{\frac{a}{\cos \phi}} r^3 dr d\phi$$

2. Sketch the domains whose areas are described by the following integrals. Change the order of integration and calculate the areas.

$$A = \int_0^1 \int_x^{2-x^2} dy dx$$

$$A = \int_{-2}^0 \int_{y^2-4}^0 dx dy$$

3. Evaluate the following integrals:

$$\int_{\phi=0}^{\pi/2} \int_{r=0}^a \int_{z=-h/2}^{h/2} r^3 \sin \phi \cos \phi dz dr d\phi$$

$$\int_{x=0}^1 \int_{y=0}^{\sqrt{1-x^2}} \int_{z=\sqrt{x^2+y^2}}^{\sqrt{2-x^2-y^2}} z^2 dz dy dx$$

4. Solve problems 13-16 in the problem booklet.