1. Find the volume of the solid formed by rotating the region bounded by $y = x^n$, $y = 0$, $x = 1$ and $x = 2$ about the $x$-axis, here $n$ is a real number.

Using disk method, we know the volume is:

$$\int_1^2 \pi (x^n)^2 \, dx = \pi \int_1^2 x^{2n} \, dx$$

When $n \neq -\frac{1}{2}$,

$$\pi \int_1^2 x^{2n} \, dx = \pi \left. \frac{1}{2n + 1} x^{2n + 1} \right|_1^2 = \frac{\pi}{2n + 1} (2^{2n+1} - 1);$$

When $n = -\frac{1}{2}$,

$$\pi \int_1^2 x^{2n} \, dx = \pi \int_1^2 x^{-1} \, dx = \pi \ln |x| \bigg|_1^2 = \pi \ln 2.$$

2. Set up, but do not evaluate, an integral for the area of the region enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

First we express $y$ as a function of $x$:

$$y = \pm \sqrt{b^2 \left(1 - \frac{x^2}{a^2}\right)} = \pm b \sqrt{1 - \frac{x^2}{a^2}},$$
The curve above $x$-axis is $y = b\sqrt{1 - \frac{x^2}{a^2}}$, and the curve under $x$-axis is $y = -b\sqrt{1 - \frac{x^2}{a^2}}$. So the area we want is:

$$
\int_{-a}^{a} b\sqrt{1 - \frac{x^2}{a^2}} - (-b\sqrt{1 - \frac{x^2}{a^2}}) \, dx = 2 \int_{-a}^{a} b\sqrt{1 - \frac{x^2}{a^2}} \, dx.
$$