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easy calculation of the area of an ellipse

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Owner	cvalente (11260)
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Author	cvalente (11260)
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Consider the unit circle $\{(x, y) \in \mathbb{R}^2 : x^2 + y^2 \leq 1\}$. It's a well known fact that the area of this set is π .

Now consider the following linear transformation $(x, y) \rightarrow (u, v) = (ax, by)$.

The determinant of the transformation is ab and the transformed circle is:

$\{(u, v) \in \mathbb{R}^2 : \left(\frac{u}{a}\right)^2 + \left(\frac{v}{b}\right)^2 \leq 1\}$ an ellipse of axis (a, b) .

Now since the Jacobian of the transformation is constant, the <http://planetmath.org/ChangeOfVariables> theorem allows us to say the area of the transformed set is ab times the area of the original set.

Thus, the area of an ellipse is πab .