

## Integration (by Substitution) Steps:

Example:  $\int_1^2 \frac{x}{x^2+1} dx$

### 1 Make a suitable substitution $u = ?$

Usually the expression **in a bracket**, or the “more complicated” expression.

Let  $u = x^2 + 1$

### 2 Find $\frac{du}{dx}$ and make $dx$ the subject.

$$\frac{du}{dx} = 2x$$

$$dx = \frac{1}{2x} du$$

### 3 Substitute in to make integral entirely in terms of “u”

$$\int \frac{x}{u} \cdot \frac{1}{2x} du = \frac{1}{2} \int \frac{1}{u} du$$

### 4 Integrate & substitute back so that entirely in terms of “x”

$$\frac{1}{2} \int \frac{1}{u} du = \frac{1}{2} \ln|u| = \frac{1}{2} \ln|x^2 + 1|$$

### 5 (For definite integrals) Sub. In Top Limit – Sub. In Bottom

$$\left[ \frac{1}{2} \ln|x^2 + 1| \right]_1^2 = \frac{1}{2} \ln 5 - \frac{1}{2} \ln 2 = 0.458$$