

As you are probably aware, the command **int** in Maple is a quick and powerful tool for evaluating all sorts of integrals. However, with this command, you do not get to see the steps that lead to the answer. There are two commands, **changevar** and **intparts**, in the Student Library of Maple that let you perform substitutions and do integration by parts step by step. You decide what to pick for w or for u and dv and Maple shows the result of your choice. After working through the examples below, try applying these commands to homework problems.

Example 1. To make the substitution $w = 1 - x^2$ in the integral $\int \frac{x^3 dx}{\sqrt{1-x^2}}$, first load the student library with the command

```
> with(student);
```

and then type (with careful attention to `Int`, not `int`).

```
> changevar(w=1-x^2, Int(x^3/sqrt(1-x^2), x), w);
```

To simplify the integrand that results, use the command **simplify**:

```
> simplify(%);
```

To evaluate the integral, use the command *value*.

```
> value(%);
```

If you wish to see the answer in terms of the original variable, then type:

```
subs(w=1-x^2, %);
```

Here is another example showing how to handle definite integrals.

Example 2. To handle the integral $\int_{-1}^1 \frac{e^x}{\sqrt{1+e^{2x}}} dx$, type:

```
> changevar(w=exp(x), Int(exp(x)/sqrt(1+exp(2*x)), x=-1..1), w);
```

The integral that results calls for a trig substitution of the form $w = \tan(t)$ (covered in section /8.3). Because of the way Maple simplifies, it is better to make all trig substitutions in terms of sin and cos. Thus we type:

```
> changevar(w=sin(t)/cos(t),%,t);
```

We can then simplify and evaluate this integral as in the previous example.

The syntax for **intparts** is `intparts(Int(integrand,var),u_as_expression)`. Here is an example.

Example 3. To integrate $\int x^3 e^{-x} dx$, type:

```
> intparts(Int(x^3*exp(-x),x),x^3);
```

then

```
> intparts(%,x^2);
```

then

```
> intparts(%,x);
```

and finally

```
> value(%);
```

Note that many of the problems from /8.2 boil down to a substitution.

Example 4. To integrate $\int \sin^3 x \cos^4 x dx$ type:

```
> changevar(w=cos(x),Int((sin(x))^3*(cos(x))^4,x),w);
```

In /8.2 there are also occasions to do algebraic substitutions (as opposed to change of variable substitutions). The command **subs** with format `subs(old=new, in_expression)` handles this situation, as illustrated by the following example.

Example 5. To integrate $\int \cos^6 x dx$ we first change $\cos^2 x$ by applying the double angle formula $\cos^2 x = \frac{1}{2}(1 + \cos 2x)$. In Maple, we must use $\cos x = \sqrt{\frac{1}{2}(1 + \cos 2x)}$. Thus, type:

```
> subs(cos(x)=sqrt((1/2)*(cos(2*x)+1)),(cos(x)^6));
```

We can then expand the expression that we get with the **simplify** command.