

Lab 3.

Integration by Substitution.

This lab will check out your ability to determine antiderivatives by the substitution technique. See sections 7.2 and 7.3 in your book. We are going to use Maple V for this.

First you must bring up the Maple file *with(student)*; When you do this you will see a whole list of commands but the one we are interested in is *changevar*. This is short for “change of variable” which is just another name for substitution. If you make the correct substitution in the integrals below, you will get an integral in the table on pages 366/367.

We’ll work an example to show you what we want you to do.

Let’s work #22 on page 353: $\int x^2 e^{x^3+1} dx$

Bring up a Maple window and issue the commands:

```
> with(student);  
> f:=x^2*exp(x^3+1);  
> F:=Int(f,x);  
> uintegral:=changevar(x^3+1=u,F,u);
```

This integral is #3 in the table with $a=e$. This integral then is

$$\frac{1}{3}e^u + C,$$

giving us, after substituting back, the answer $\int x^2 e^{x^3+1} dx = \frac{1}{3}e^{x^3+1} + C$.

These last few steps can be achieved in Maple by

```
uanswer:=value(uintegral)+C;  
F:="subs(u=x^3+1,uanswer);
```

Now work the following. Remember you must get an integral in the table on page 366/7.

Problems.

1) $\int x^2 \sqrt{2x^3 - 4} dx,$

2) $\int \frac{\cos(x)}{1 + \sin^2(x)} dx,$

3) $\int 2^{\sin(x)} \cos(x) dx,$

4) $\int \frac{\sec^2(x)}{1 + \tan(x)} dx,$

5) $\int \frac{1}{100 + 9x^2} dx,$

6) $\int \frac{1}{\sqrt{16x^2 + 9}} dx,$

7) $\int \frac{3x}{\sqrt{1 - x^2}} dx,$

8) $\int \frac{e^{\sqrt{x+1}}}{\sqrt{x+1}} dx,$

9) $\int \frac{1}{x\sqrt{x^2 - 1}} dx,$

$$10) \int \frac{1}{x\sqrt{1-x^2}} dx.$$

$$11) \int \frac{\ln(x)}{x} dx.$$

$$12) \int \frac{\sin(2x)}{\sqrt{1-\cos(2x)}} dx.$$

$$13) \int \frac{\sin(4x)}{\cos(2x)} dx.$$

$$14) \int \sec^2(2x-1) dx.$$

$$15) \int x e^{x^2} dx.$$