Example Technology Exercise 8
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1 Problem 8.2.87

The instructions said to find the results for n=0,1,2,3
but since we're going to need to verify for n=4, let's go
ahead and find it, too.

(%i1) makelist(integrate(x^n*log(x),x),n,0,4),factor;

(%o1) $[x\left(\log(x)-1\right), \frac{x^2\left(2\log(x)-1\right)}{4}, \frac{x^3\left(3\log(x)-1\right)}{9}, \frac{x^4\left(4\log(x)-1\right)}{16}, \frac{x^5\left(5\log(x)-1\right)}{25}]$

If you let N = n+1, then this looks like

(%i2) x^N*(N*log(x)-1)/N^2;
subst(N=n+1,%);

(%o2) $\frac{x^N\left(\log(x)\,N-1\right)}{N^2}$

(%o3) $\frac{x^{n+1}\left(\left(n+1\right)\log(x)-1\right)}{\left(n+1\right)^2}$

We'll verify by plugging in n=4

(%i4) subst(n=4,%);

(%o4) $\frac{x^5\left(5\log(x)-1\right)}{25}$

That matches what we were supposed to get.

2 Problem 8.3.78

(%i5) integrate(tan(1-x)^3,x);

(%o5) $\frac{1}{2\sin(x-1)^2-2}-\frac{\log\left(\sin(x-1)^2-1\right)}{2}$

3 Problem 8.4.55

(%i6) integrate(x^2/sqrt(x^2+10*x+9),x),ratsimp;

(%o6) $\frac{66\log\left(2\sqrt{x^2+10x+9}+2x+10\right)+(x-15)\sqrt{x^2+10x+9}}{2}$

4 Problem 8.4.35 -- Find partial fraction decomposi

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Write the partial fraction expansion and then
multiply by the LCD to get rid of the fractions
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(%i7) fraction:(x^2+x+2)/(x^2+2)^2$
expansion:(A*x+B)/(x^2+2)+(C*x+D)/(x^2+2)^2$
eqn:denom(fraction)*(fraction=expansion),factor;

(%o9) $x^2+x+2=D+x\,C+x^2\,B+2\,B+x^3\,A+2\,x\,A$

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Set the coefficients of the same powered terms equal to each other.
Then solve the system of resulting equations for the constants.
Finally, substitute the constants back into the original equation
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(%i10) makelist(coeff(eqn,x,n),n,0,3);
solve(%,[A,B,C,D])[1];
subst(%,expansion);

(%o10) $[2=D+2\,B,1=C+2\,A,1=B,0=A]$

(%o11) $[A=0,B=1,C=1,D=0]$

(%o12) $\frac{1}{x^2+2}+\frac{x}{\left(x^2+2\right)^2}$

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Now check with partfrac command
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(%i13) partfrac(fraction,x);

(%o13) $$\frac{1}{x^2+2}+\frac{x}{\left(x^2+2\right)^2}$$