Math 152 - Worksheet 1

The Substitution Method

Learning Problems

These problems should be completed on your own. If you need hints on solving a problem, there are some provided with each problem. These are provided on the following pages, with one 'level' of hint per page, with the earlier ones giving away less of the problem than the later ones. Try to work from the earlier hints to the later ones, as this will give you the practice you need to succeed in this class.

1. Compute $\int \cos(8x - 5)\ dx$
2. Compute $\int x^{15}(x^{16} + 5)^{5/2}\ dx$
3. Compute $\int x^5(x^2 - 3)^{3/2}\ dx$
4. Compute $\int_3^6 3x(x^2 + 4)^3\ dx$
5. Compute $\int_0^4 \dfrac{2x^2}{x^3 + 2}\ dx$
6. Compute $\int \dfrac{x^2}{x^6 + 5}\ dx$

Submission Problems

1. Compute $\int \dfrac{x^3 + x}{(x^4 + 2x^2 + 3)^3}\ dx$
2. Compute $\int_1^2 e^x \sin(e^x + 4)\ dx$

Hint #1

1. What is the inside function here? Try making that u.
2. What should an inside function be for this?
3. What should an inside function be for this? Try making that u.
4. What should an inside function be for this?
5. What should we treat as an inside function here?
6. What is your first thought for u? Does this work for this integral?

Hint #2

1. Set $u = 8x - 5$. What is du? What does the integral become?
2. Try $u = x^{16} + 5$. How does du factor into this integral?
3. After the substitution, you end up with both x and u in the expression. You need to make that only in terms of u. How can you do this? How can you get rid of x?
4. Try $u = x^2 + 4$. How does du factor into this integral?
5. Try $u = x^3 + 2$. What is du?
6. If you try $u = x^6 + 5$, there's no way to make the du work. If this doesn't work, a last option would be the inverse trig integrals. Does one of these apply here?

Hint #3

3. Try $u = x^2 - 3$. This means that $x^2 = u + 3$, so that $x^4 = (u + 3)^2$.
4. Don't forget to change the bounds on the integral.
5. The integral should reduce to $\int_2^{66} \frac{2}{3}\frac{1}{u}\, du$
6. Try to make this look like the derivative of inverse tangent. You'll need to take care of the x^6 term as well as the 5.

Hint #4

3. The integral reduces to $\int \frac{1}{2}(u+3)^2 u^{3/2} du$

4. The integral reduces to $\int_{13}^{40} \frac{3}{2} u^3 \, du$.

6. Write the integrand as $\frac{1}{5}\frac{x^2}{(\frac{x^6}{5}+1)}$ and the set $u = \frac{x^3}{\sqrt{5}}$.

Answers

1. $\frac{1}{8}\sin(8x-5)+C$
2. $\frac{1}{56}(x^{16}+5)^{7/2}+C$
3. $\frac{1}{315}(x^2-3)^{5/2}(35x^4+60x^2+72)+C$
4. 949290
5. $\frac{2}{3}\ln 33$ (after applying logarithm rules)
6. $\frac{1}{3\sqrt{5}}\tan^{-1}(\frac{x^3}{\sqrt{5}})+C$