Occidental College Department of Mathematics
Gateway – Integrals
Help Sheet

This sheet is to provide you with further information as you work toward achieving 90% proficiency on this gateway on **integrals**. As you look through the key ideas below, try to create a realistic picture of what you understand and what you don't — the first attempt at the gateway should help you with this. While preparing for the second attempt, you should take full advantage of working with your peers, seeking help from other students (both in this course and others), seeing the peer counselors and professional staff at the Center for Teaching and Learning, and talking with your professors.

You need to know how to find the family of antiderivatives (or indefinite integral) of the following types of functions, or how to use the following methods. Examples given are functions you should be able to antidifferentiate. You should also be able to evaluate definite integrals using the fundamental theorem of calculus.

1. Ex: $\int (6x^5 - 3x^2 + 7x)dx$. Finding the indefinite integral for a polynomial is done term by term, using the fact that

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + C$$

for $n \neq -1$.

2. Ex: $\int (2x-1)(2x^2-2x)^6 dx$. Here, a simple u-substitution is required.

3. Ex: $\int \sec^2(1+2x)dx$, $\int \cos(x)\sin^3(x)dx$ and $\int \frac{ln(x)}{x}dx$. Exponential, logarithmic and trigonometric functions can serve as either the u-substitution or contain the u-substitution.

4. Ex: $\int \frac{3}{x^{\frac{7}{5}}}dx$ Integrands involving fractional exponents. Sometimes it is best to express such integrands using negative exponents before antidifferentiating.

5. Ex $\int \frac{\cos(x)}{\sqrt{\sin(x)}}dx$ Here, we combine fractional power functions with u-substitution or integration by parts.

6. Ex: $\int x\sin(x)dx$. One-step integration by parts.

7. Ex: $\int e^x \sin(e^x)dx$. Open. This one may be u-substitution or integration by parts or you may need to do some algebraic manipulation before integrating.

8.–10. Evaluating definite integrals. Leave your answer in exact form.
Ex: $\int_2^3 \ln(x)\, dx$, $\int_\pi^{\frac{7\pi}{6}} \tan(x)\, dx$ and $\int_0^3 x\sqrt{x+1}\, dx$.
In the last three problems, you will be asked to use the fundamental theorem of calculus to evaluate definite integrals.