

Things You Should Be Able to Do on Day One

- Derivatives. Know the product rule, quotient rule, chain rule. Know the derivative of all six trig functions, natural log, arcsine and arctangent.
- Integration. You should know basic integration techniques and u -substitution.
- Know the antiderivative of all six trig functions and the antiderivatives of the derivatives of all six trig functions (i.e. know the antiderivative of $\sec^2 x$).
- You should have the power reducing identities memorized for $\sin^2(\theta)$ and $\cos^2(\theta)$.
- Know the integrals that result in arcsine and arctangent.
- Integration-by-parts
- Partial fraction decomposition

The following exercises should be completed from memory, without the use of your book or other references. This will give you an idea of what is expected of you coming into Ordinary Differential Equations.

1. Find the derivative of each of the following equations.

(a) $f(x) = e^{3x^2}$

(b) $g(x) = \sqrt{x^4 - 1}$

(c) $y = \ln(5x^2 + 2)$

(d) $h(\theta) = \cos^2 \theta$

(e) $r(\phi) = \sec \phi \tan \phi$

(f) $s(t) = \frac{\sec t}{1 + \csc t}$

3. Evaluate using integration by parts.

(a) $\int x e^{3x} dx$

(b) $\int v^2 \ln(v) dv$

4. Evaluate using partial fraction decomposition.

$$\int \frac{5u + 1}{u^2 - 1} du$$

2. Evaluate each integral.

(a) $\int (3x^2 - 4x + 7) dx$

(b) $\int \frac{t}{t^2 + 1} dt$

(c) $\int \tan \theta d\theta$

(d) $\int \sec^2 y dy$

Answers

1. (a) $6xe^{3x^2}$
(b) $\frac{2x^3}{\sqrt{x^4 - 1}}$
(c) $\frac{10x}{5x^2 + 2}$
(d) $-2 \cos \theta \sin \theta$
(e) $\sec^3 \phi (\sin^2 \phi + 1)$
(f) $\frac{\sec t \tan t + \sec^2 t + \csc^2 t}{(1 + \csc t)^2}$
2. (a) $x^3 - 2x^2 + 7x + C$
(b) $\ln \sqrt{t^2 + 1} + C$
(c) $\ln |\sec \theta| + C$
(d) $\tan x + C$
3. (a) $\frac{1}{9}e^{3x}(3x - 1) + C$
(b) $\frac{v^3}{9}(3 \ln(v) - 1) + C$
4. $\ln(u + 1)^2 + \ln |u - 1|^3 + C$