

Substitute u in this space: Key

AP Calculus AB: 6.3 U-Substitution

1.  $\int 16(4x+5)^3 dx$

$u = 4x+5$   
 $du = 4 dx$   
 $dx = \frac{du}{4}$   
 $\int 16(u)^3 \frac{du}{4}$   
 $\frac{16u^4}{4} \cdot \frac{1}{4} = u^4 + C$   
 $f(x) = (4x+5)^4 + C$

3.  $\int 3\sqrt[4]{6x+2} dx$

$u = 6x+2$   
 $du = 6 dx$   
 $dx = \frac{du}{6}$   
 $\int 3(u)^{1/4} \frac{du}{6}$   
 $\frac{3u^{5/4}}{5} \cdot \frac{1}{2} + C$   
 $\frac{2(6x+2)^{5/4}}{5} + C$

5.  $\int x\sqrt{x^2+7} dx$

$u = x^2+7$   
 $du = 2x dx$   
 $dx = \frac{du}{2x}$   
 $\int x(u)^{1/2} \frac{du}{2x}$   
 $\frac{2u^{3/2}}{3} \cdot \frac{1}{2} + C$   
 $\frac{(x^2+7)^{3/2}}{3} + C$

7.  $\int \frac{(\sqrt{x}+3)^3}{\sqrt{x}} dx$

$u = x^{1/2}+3$   
 $du = \frac{1}{2}x^{-1/2} dx$   
 $du = \frac{1}{2\sqrt{x}} dx$   
 $dx = 2\sqrt{x} du$   
 $\int \frac{u^3}{\sqrt{x}} 2\sqrt{x} du$   
 $\frac{2u^4}{4} + C$   
 $\frac{(x^{1/2}+3)^4}{2} + C$

9.  $\int \frac{x}{4\sqrt{x^2+1}} dx$

$u = x^2+1$   
 $du = 2x dx$   
 $dx = \frac{du}{2x}$   
 $\int \frac{x u^{-1/2}}{4} \frac{du}{2x}$   
 $\frac{1}{4} \cdot \frac{2u^{1/2}}{1} \cdot \frac{1}{2} + C$   
 $\frac{(x^2+1)^{1/2}}{4} + C$

2.  $\int \sqrt{2x-7} dx$

$u = 2x-7$   
 $du = 2 dx$   
 $dx = \frac{du}{2}$   
 $\int (u)^{1/2} \frac{du}{2}$   
 $\frac{2u^{3/2}}{3} \cdot \frac{1}{2} + C$   
 $\frac{(2x-7)^{3/2}}{3} + C$

4.  $\int 2(5x+1)^{5/3} dx$

$u = 5x+1$   
 $du = 5 dx$   
 $dx = \frac{du}{5}$   
 $\int 2(u)^{5/3} \frac{du}{5}$   
 $\frac{2u^{8/3}}{5} + C$   
 $\frac{6(5x+1)^{8/3}}{25} + C$

6.  $\int 12x^2(1-2x^3)^3 dx$

$u = 1-2x^3$   
 $du = -6x^2 dx$   
 $dx = \frac{du}{-6x^2}$   
 $\int 12x^2(u)^3 \frac{du}{-6x^2}$   
 $-\frac{2u^4}{24} + C$   
 $-\frac{(1-2x^3)^4}{2} + C$

8.  $\int (x+3)\sqrt{x^2+6x-7} dx$

$u = x^2+6x-7$   
 $du = 2x+6 dx$   
 $dx = \frac{du}{2x+6} = \frac{du}{2(x+3)}$   
 $\int (x+3) u^{1/2} \frac{du}{2(x+3)}$   
 $\frac{2u^{3/2}}{3} \cdot \frac{1}{2} + C$   
 $\frac{(x^2+6x-7)^{3/2}}{3} + C$

10.  $\int (6x+12)\sqrt{x^2+4x+3} dx$

$u = x^2+4x+3$   
 $du = 2x+4 dx$   
 $dx = \frac{du}{2x+4}$   
 $\int 3(2x+4) u^{1/2} \frac{du}{2x+4}$   
 $\frac{3}{1} \cdot \frac{2u^{3/2}}{3} + C$   
 $2(x^2+4x+3)^{3/2} + C$

11. If a particles velocity is determined by a function  $v(t) = \frac{6x^3+2\sqrt{x}}{x}$ , and the particles passes through the position  $x(1)=12$ , find the position of the particle at the time  $t=0$ .