# 5.2 Natural Log Integration

pg. 334 #'s 1-11 odd, 21-25 odd, 97

1) $\int \frac{5}{x}dx$

$5\int \frac{1}{x}dx$

$\boxed{5\ln|x|+C}$

3) $\int \frac{1}{x+1}dx$ $u=x+1$ $du=dx$

$\int \frac{1}{u}du$

$\ln|u|+C$

$\boxed{\ln|x+1|+C}$

5) $\int \frac{1}{2x+5}dx$ $u=2x+5$ $du=2dx$ $\frac{1}{2}du=dx$

$\frac{1}{2}\int \frac{1}{u}du$

$\frac{1}{2}\ln|u|+C$

$\boxed{\frac{1}{2}\ln|2x+5|+C}$

7) $\int \frac{x}{x^2-3}dx$ $u=x^2-3$ $du=2xdx$ $\frac{1}{2}du=xdx$

$\frac{1}{2}\int \frac{1}{u}du$

$\frac{1}{2}\ln|u|+C$

$\boxed{\frac{1}{2}\ln|x^2-3|+C}$

9) $\int \frac{4x^3+3}{x^4+3x}dx$ $u=x^4+3x$ $du=4x^3+3$

$\int \frac{1}{u}du$

$\ln|u|+C$

$\boxed{\ln|x^4+3x|+C}$

11) $\int \frac{x^2-4}{x}dx$

$\int x\,dx - 4\int \frac{1}{x}dx$

$\boxed{\frac{1}{2}x^2-4\ln|x|+C}$

21) $\int \frac{(\ln x)^2}{x}dx$ $u=\ln x$ $du=\frac{1}{x}dx$

$\int u^2\,du$

$\frac{1}{3}u^3+C$

$\boxed{\frac{1}{3}(\ln x)^3+C}$

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

$-\frac{2}{3}\int \frac{1}{u}du$

$-\frac{2}{3}\ln|u|+C$

$\boxed{-\frac{2}{3}\ln|1-3\sqrt{x}|+C}$

25) $\int \frac{2x}{(x-1)^2}$ $u = x-1 \rightarrow x = u+1$

$du = dx$

$\int \frac{2(u+1)}{u^2} du$

$\int \frac{2u+2}{u^2} du$

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

$2\ln|u| - 2u^{-1} + C$

$\boxed{2\ln|x-1| - \frac{2}{x-1} + C}$

97) $\int \frac{dP}{dt} = \int \frac{3000}{1+.25t}$

$P = 3000\int \frac{1}{1+.25t} dt$ $u = 1+.25t$, $du = .25dt$, $4du = dt$

$P = 12000\int \frac{1}{u} du$

$P = 12000\ln|u| + C$

$P = 12000\ln|1+.25t| + C$

$1000 = 12000\ln|1+0| + C$

$1000 = 12000(0) + C$

$1000 = C$

$\boxed{P(t) = 12000\ln|1+.25t| + 1000}$

$P(3) = 12000\ln|1+.75| + 1000$

$P(3) = 7715.389$

$\boxed{P(3) \approx 7715}$