Integrating Exponential Functions

p. 386 - 392 (5.5)

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1. $\int e^x\,dx = e^x + C$

2. $\int e^u\,du = e^u + C$ (BE CAREFUL, you have to do u-subst.)

Integrate:

1. $\int e^{(3x+1)}\,dx$

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

$= \int e^u \frac{du}{3} = \frac{1}{3}\int e^u du$

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

$= \frac{1}{3}e^{3x+1} + C$

2. $\int 5x(e)^{-(x^2)}\,dx$

$= 5\int x e^{-x^2} dx$

$u = -x^2$
$du = -2x\,dx$
$dx = \frac{du}{-2x}$

$= 5\int x e^u \frac{du}{-2x}$

$= \frac{5}{-2}\int e^u du$

$= -\frac{5}{2}e^u + C \quad = -\frac{5}{2}e^{-x^2} + C$

**3. $\int \frac{e^{(\tan x)}}{\cos^2 x}\,dx$

$= \int e^{\tan x}\left(\frac{1}{\cos^2 x}\right)dx \quad = \int e^{\tan x}(\sec^2 x)\,dx$

$u = \tan x$
$du = \sec^2 x\,dx$
$dx = \frac{du}{\sec^2 x}$

$= \int e^u \sec^2 x \frac{du}{\sec^2 x} = \int e^u du$

$= e^u + C \quad = e^{\tan x} + C$

**(FR) 4. The acceleration of a particle moving along a straight line is given by $a = 10e^{2t}$.

a) Write an expression for the velocity v, in terms of time t, if $v = 5$ when $t = 0$.

$v(t) = \int a(t)\,dt = \int 10e^{2t}\,dt$

$u = 2t$
$du = 2dt$
$dt = \frac{du}{2}$

$= 10\int e^u \frac{du}{2} = 5\int e^u du = 5e^u + C$

$v(t) = 5e^{2t} + C$

$v(0) = 5e^0 + C = 5$

$5 + C = 5$
$C = 0$

$v(t) = 5e^{2t}$