Opener

$\int x\,f(x)\,dx =$

(A) $x\,f(x) - \int x\,f'(x)\,dx$

(B) $\frac{x^2}{2}f(x) - \int \frac{x^2}{2}f'(x)dx$

(C) $x\,f(x) - \frac{x^2}{2}f(x) + C$

(D) $x\,f(x) - \int f'(x)\,dx$

(E) $\frac{x^2}{2}\int f(x)\,dx$

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Non-Calculator

$$\int_0^{\frac{\pi}{2}} x\cos x\,dx =$$

(A) $-\frac{\pi}{2}$ (B) -1 (C) $1-\frac{\pi}{2}$ (D) 1 (E) $\frac{\pi}{2}-1$

$$\int x\sec^2 x\,dx =$$

(A) $x\tan x + C$

(B) $\frac{x^2}{2}\tan x + C$

(C) $\sec^2 x + 2\sec^2 x\ \tan x$

(D) $x\tan x - \ln|\cos x| + C$

(E) $x\tan x + \ln|\cos x| + C$

6-3 day 2 Integration by Parts: Tabular Method

Learning Objectives:

I evaluate an integral using integration by parts tabular method.

Ex1. Evaluate

1.) $\int \underbrace{x^2}_{u} \underbrace{\cos x\,dx}_{dv}$

$u = x^2 \qquad dv = \cos x$
$du = 2x \qquad v = \sin x$

$= x^2 \cdot \sin x - \int \sin x \cdot 2x\,dx$

$= x^2 \sin x - \boxed{\int 2x \sin x\,dx}$

$u = 2x \qquad dv = \sin x$
$du = 2 \qquad v = -\cos x$

$= x^2 \sin x - \left[2x \cdot -\cos x - \int -\cos x \cdot 2\,dx\right]$

$= x^2 \sin x - \left[-2x\cos x + \int 2\cos x\,dx\right]$

$= x^2 \sin x + 2x\cos x - 2\int \cos x\,dx$

$\boxed{= x^2 \sin x + 2x\cos x - 2\sin x + C}$

DER	A.D
$+\ x^2$	$\cancel{\cos x}$
$-\ 2x$	$\sin x$
$+\ 2$	$-\cos x$
$\cancel{0}$	$-\sin x$

$$x^2\sin x + 2x\cos x - 2\sin x + C$$

2.) $\boxed{\int x^3 e^x dx}$

DER A.D.

$u = x^3$ $dv = e^x$

$du = 3x^2$ $v = e^x$

$x^3e^x - \int 3x^2e^x dx$

$u = 3x^2$ $dv = e^x$

$x^3e^x - \left(3x^2e^x - \int 6xe^x dx\right)$

$du = 6x$ $v = e^x$

$u = 6x$ $dv = e^x$

$x^3e^x - \left(3x^2e^x - \left(6xe^x - \int 6e^x dx\right)\right)$

$du = 6$ $v = e^x$

$\boxed{+x^3e^x - 3x^2e^x + 6xe^x - 6e^x + C}$

f AD f' AD f'' AD f''' AD

	DER	A.D.
$+$	x^3	$\cancel{e^x}$
$-$	$3x^2$	e^x
$+$	$6x$	e^x
$-$	6	e^x
	$\cancel{0}$	e^x

$$x^3e^x - 3x^2e^x + 6xe^x - 6e^x + C$$

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

DER	Anti
$+\ x^5$	e^{-2x}
$-\ 5x^4$	$-\frac{1}{2}e^{-2x}$
$+\ 20x^3$	$\frac{1}{4}e^{-2x}$
$-\ 60x^2$	$-\frac{1}{8}e^{-2x}$
$+\ 120x$	$\frac{1}{16}e^{-2x}$
$-\ 120$	$-\frac{1}{32}e^{-2x}$
$\cancel{0}$	$\frac{1}{64}e^{-2x}$

$$= x^5\left(-\tfrac{1}{2}e^{-2x}\right) - (5x^4)\left(\tfrac{1}{4}e^{-2x}\right) + (20x^3)\left(-\tfrac{1}{8}e^{-2x}\right) -$$
$$(60x^2)\left(\tfrac{1}{16}e^{-2x}\right) + (120x)\left(-\tfrac{1}{32}e^{-2x}\right) -$$
$$120\left(\tfrac{1}{64}e^{-2x}\right)$$

$$= \boxed{-\tfrac{1}{2}x^5e^{-2x} - \tfrac{5}{4}x^4e^{-2x} - \tfrac{5}{2}x^3e^{-2x} - \tfrac{15}{4}x^2e^{-2x} - \tfrac{15}{4}xe^{-2x} - \tfrac{15}{8}e^{-2x} + C}$$

4.) $\int e^x \cos x dx$

$u = \cos x \qquad dv = e^x$

$du = -\sin x \qquad v = e^x$

$\int e^x \cos x dx = e^x \cos x - \int -e^x \sin x dx$

$\int e^x \cos x dx = e^x \cos x + \boxed{\int e^x \sin x dx}$

$u = \sin x \qquad dv = e^x$

$du = \cos x \qquad v = e^x$

$\int e^x \cos x dx = e^x \cos x + e^x \sin x - \cancel{\int e^x \cos x dx}$

$+ \int e^x \cos x dx \qquad + \cancel{\int e^x \cos dx}$

$\frac{\cancel{2}\int e^x \cos x dx}{\cancel{2}} = \frac{e^x \cos x + e^x \sin x}{2}$

$$\boxed{\int e^x \cos x dx = \frac{e^x \cos x + e^x \sin x}{2} + C}$$

Homework

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