$$(fg)' = f'g + fg'$$

$$-fg' = f'g - (fg)'$$

$$fg' = (fg)' - f'g$$

$$\int fg' = \int (fg)' - \int f'g$$

$$\int fg' = fg - \int f'g$$

$$\int u\,dv = uv - \int v\,du$$

u = something we can differentiate
(that preferably disappears after awhile)
$x^n = u$

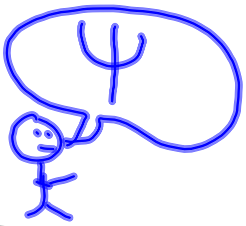
dv = something we can antidifferentiate

$$\int x \sin x \, dx \qquad \int x e^x \, dx$$

$u = x$, $dv = \sin x \, dx$

$du = dx$, $v = -\cos x$

$$uv - \int v\,du = -x\cos x + \int \cos x \, dx$$



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

$$\int \ln x \, dx$$

$u = \ln x \quad du = \frac{1}{x}\,dx$

$dv = dx \quad v = x$

$$\Rightarrow uv - \int v\,du = x\ln x - \overbrace{\int x \cdot \frac{1}{x}\,dx}^{\int dx}$$

$$= \boxed{x\ln x - x + C}$$

$\int x^2 e^x dx$ requires two IBPs.

$u = x^2 \quad du = 2x\,dx$

$dv = e^x dx \quad v = e^x \quad$ etc.

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TABULAR METHOD

$\int x^2 e^x \, dx$

	u		dv	
1	x^2	$+$	e^x	
2	$2x$	$-$	e^x	
3	2	$+$	e^x	
	0	$-$	e^x	DONE

$$\int x^2 e^x \, dx = \underset{1}{x^2 e^x} - \underset{2}{2x e^x} + \underset{3}{2e^x} + C$$

$$\int e^x \sin x \, dx$$

u		dv
$\sin x$	+	e^x
$\cos x$	−	e^x
$-\sin x$	+	e^x
$-\cos x$	−	e^x
$\sin x$		e^x
		e^x

$$\Rightarrow \int e^x \sin x \, dx = e^x \sin x - e^x \cos x - \boxed{\int e^x \sin x \, dx} \ldots$$

Let $u = \sin x$, $du = \cos x \, dx$

$dv = e^x dx$, $v = e^x$

$$\Rightarrow uv - \int v \, du = e^x \sin x - \int e^x \cos x \, dx$$

$u = \cos x$ $du = -\sin x \, dx$

$dv = e^x dx$ $v = e^x$

$$\Rightarrow e^x \sin x - \left[e^x \cos x + \int e^x \sin x \, dx \right] = \int e^x \sin x \, dx + \hat{C}$$

$$* \int e^x \sin x \, dx = e^x \sin x - e^x \cos x - \int e^x \sin x \, dx + \hat{C}$$

$$2 \int e^x \sin x \, dx = e^x \sin x - e^x \cos x + \hat{C}$$

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

where $C = \frac{\hat{C}}{2}$

Pg 439 What am I missing?

$$\int \cos^3 x \, dx$$

$\boxed{M2}$ $\boxed{8.2 \text{ way}}$

$$= \int \overbrace{(1-\sin^2 x)}^{\cos^2 x} \cos x \, dx$$

$$= \int \cos x \, dx - \int \underbrace{\sin^2 x}_{u^2} \cdot \underbrace{\cos x \, dx}_{du}$$

$$= \sin x - \underbrace{\frac{\sin^3 x}{3}}_{\frac{u^3}{3}} + C$$

§8.1 way

$$\int \cos^3 x \, dx = \int \cos^2 x \cos x \, dx$$

$u = \cos^2 x \qquad du = -2\cos x \sin x \, dx$

$dv = \cos x \, dx \qquad v = \sin x$

$$\Rightarrow uv - \int v\,du = \cos^2 x \sin x + 2\int \sin^2 x \cos x \, dx$$

$$= \sin x \underbrace{\cos^2 x}_{(1-\sin^2 x)} + \frac{2}{3}\sin^3 x + C$$

$$= \sin x - \frac{\sin^3 x}{3} + C$$

Book got

$$\frac{\sin x \cos^2 x}{3} + \frac{2}{3}\sin x + C$$

$$= \frac{\sin x - \sin^3 x}{3} + \frac{2}{3}\sin x + C$$

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

ok. Book is ok

I'm ok

you're ok.

Homework :

$2n$

$$\boxed{\int \cos^5 x \, dx \qquad \int \cos^6 x \, dx}$$

ODD: Let $du = \cos x \, dx$ (or $\sin x \, dx$, when $\sin^{2n+1}(x) \, dx$)

and write $\underline{\cos^{2n} x}$ as $(1-\sin^2 x)^n$

$\to (\cos^2 x)^n$

Even:

$$\sin^2 x = \frac{1-\cos(2x)}{2}$$

$$\cos^2 x = \frac{1+\cos(2x)}{2}$$

$$\int \cos^5 x \, \sin^7 x \, dx$$

$$= \int \sin^7 x \, \boxed{\underline{(1-\sin^2 x)^2}} \cos x \, dx$$

$$\to \cos^4 x = \underline{(\cos^2 x)}^2 = ((\cos x)^2)^2$$

$$\to (1-\sin^2 x)^2$$

$=$

§8.1
#26, 32, 40, 54

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