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① $\int e^x \sin x \, dx$ ②

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

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

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

$= (\sin x)(e^x) - \int e^x \cos x \, dx$

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

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

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

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

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

$= e^x \cos x - \int e^x(-\sin x \, dx)$

$= e^x \cos x + \int e^x \sin x \, dx$

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

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

let $\int e^x \sin x \, dx = I$

$I = e^x \sin x \, dx = e^x \cos x - I$

$I + I = e^x \sin x - e^x \cos x$ ③

$\frac{2I}{2} = \frac{e^x \sin x}{2} - \frac{e^x \cos x}{2}$

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

$\int e^x \sin x \, dx = \frac{1}{2}[e^x \sin x - e^x \cos x] + c$

(2) $\int 2x^2 \ln x \, dx$ sol-

$2\int x^2 \ln x$

$u = \ln x \qquad dv = x^2$

$du = 1/x \, dx \qquad v = x^3/3$

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

$= 2\left[\ln(x) \times \frac{x^3}{3} - \int \frac{x^3}{3} \times \frac{1}{x}\, dx\right]$

$= 2\left[\frac{x^3 \ln(x)}{3} - \int \frac{x^2}{3}\, dx\right]$

$= 2\left[\frac{x^3 \ln(x)}{3} - \frac{1}{3}\int x^2\, dx\right]$

$= 2\left[\frac{x^3 \ln(x)}{3} - \frac{1}{3} \times \frac{x^3}{3}\right]$

$= 2\left[\frac{x^3 \ln(x)}{3} - \frac{x^3}{9}\right.$

$\therefore \int 2x^2 \ln x \, dx = \left[\frac{2}{3}x^3\left(\frac{\ln(x)}{1} - \frac{1}{3}\right)\right] + c$

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(3) (3)

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

$u = x^2 \qquad dv = \sin x$

$du = 2x\, dx \qquad v = -\cos x$

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

$= x^2(-\cos x) - \int(-\cos x) \times 2x\, dx$

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

$\int 2x\cos x\,dx$

$u = 2x \qquad dv = \cos x$

$du = 2\,dx \qquad v = \sin x$

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

$= 2x\sin x - \int \sin x \times 2\,dx$

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

$= 2x\sin x - 2(-\cos x)$

$= 2x\sin x + 2\cos x$

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

(4)

$\int x\cos x\,dx$

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

$du = 1\,dx \qquad v = \sin x$

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

$= x\sin x - \int \sin x \times 1\,dx$

$= x\sin x - \int \sin x\,dx$

$= x\sin x - (-\cos x) + c$

$= x\sin x + \cos x + c$