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Find the integral of the following

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

Solution

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

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

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

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

$\int e^x \sin x \, dx = -e^x \cos x + \left[\int e^x \cos x \, dx\right] \quad ---(1)$

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

$u = e^x \qquad du = e^x dx$

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

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

substituting eqn(ii) in eqn(i)

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

(add $\int e^x \sin x \, dx$ to both sides)

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

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

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

2) $\int 2x^2 \ln x \, dx$

s/n

$u = \ln x \quad du = 1/x \, dx$

$dv = 2x^2 \quad v = 2/3 \, x^3$

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

$= \ln x (2/3 x^3) - \int 2/3 x^3 (1/x \, dx)$

$= 2/3 x^3 \ln x - \int 2/3 x^2 \, dx.$

$= 2/3 x^3 \ln x - 2/3 \int x^2 \, dx$

$= 2/3 x^3 \ln x - 2/3 (x^3/3) + c$

$= 2/3 [x^3 \ln x - x^3/3] + c.$

Or

$= 2 [1/3 \ln(x) x^3 - 1/9 x^3] + c.$

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

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

$dv = \sin x \, dx \quad v = -\cos x$

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

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

$= -x^2 \cos x + \left[\int 2x \cos x \, dx\right] - (1)$

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

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

$dv = \cos x \quad v = \sin x$

$= 2x (\sin x) - \int \sin x (2 dx)$

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

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

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

$\int 2x \cos x \, dx = 2x \sin x + 2\cos x + c$. — (ii)

Substitute eqn (ii) in (i)

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

$= -x^2 \cos x + 2(x \sin x + \cos x) + c$.

4) $\int x \cos x \, dx$

soln.

$u = x$, $du = 1 \, dx$

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

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

$= x(\sin x) - \int \sin x (1 \, dx)$

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

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

$\int x \cos x \, dx = x \sin x + \cos x + c$.