3 $\sin 7x \cos 2x$

By Duff

$\cos A \sin B = \frac{\sin(A+B) + \sin(A-B)}{2}$

$\therefore \int \sin 7x \cos 2x = \int \frac{\sin(7x+2x) + \sin(7x-2x)}{2}$

$= \frac{1}{2}\int \sin 9x + \sin 5x$

$= \frac{1}{2}\left(\int \sin(7x+2x)dx + \int \sin(7x-2x)dx\right)$

$= \frac{1}{2}\left(\int \sin 9x\, dx + \int \sin(5x)dx\right)$

$= \frac{1}{2}\left(-\frac{1}{9}\cos(9x) - \frac{1}{5}\cos(5x)\right) + C$

4 $(2x - 3x^2)/1-x$

$\frac{2x - 3x^2}{1-x}$

Breaks down in partial fractions

$\frac{2x-3x^2}{1-x} = \frac{2x}{1-x} - \frac{3x^2}{1-x}$

$\int \frac{2x-3x^2}{1-x} = \int \frac{2x}{1-x} - \frac{3x^2}{1-x}\,dx$

$= \int \frac{2x}{1-x}dx - \int \frac{3x^2}{1-x}dx$

$= -2(-1 + x + \ln(1-x)) + 3\left(-\frac{1}{2}(1-x)^2 - 2(1-x)\right.$

$= \frac{3}{2}x^2 + x + \ln(1-x) - \frac{5}{2} + C$

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MATH104

1 $3te^{2t}$

$\int 3te^{2t} = 3\int te^{2t}$

$u = t \qquad dv = e^{2t}$

$du = 1 \qquad v = \int dv = \frac{e^{2t}}{2}$

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

$= t\left(\frac{e^{2t}}{2}\right) - \int \frac{e^{2t}}{2}(1)$

$= \frac{te^{2t}}{2} - \frac{e^{2t}}{4} + C$

2) $x^2 \sin x$

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

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

$\int u\,dv = -x^2\cos x - \int -\cos x \cdot 2x$

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

Applying integration by parts.

$\int 2x\cos x = 2(x\sin x + \cos x)$

$\int u\,dv = -x^2\cos x + 2x\sin x + 2\cos(x) + C$