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Integrate the following with respect to the integral able:

Solution.

(1) $3te^{2t} = \int 3te^{2t}\,dt$

$3\int te^{2t}\,dt$

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

where $u = t$; $e^{2t} = v$; $\frac{du}{dt} = 1$; $\int dv = \int e^{2t}$

$v = \frac{1}{2}e^{2t}$

Substitute into the equation:

$= t \cdot \frac{1}{2}e^{2t} - \int \frac{1}{2}e^{2t} \cdot dt$

$= \frac{1}{2}te^{2t} - \frac{1}{2}\int e^{2t}\,dt$

$= \frac{1}{2}te^{2t} - \frac{1}{4}e^{2t} + C$

$3\left(\frac{1}{2}te^{2t} - \frac{1}{4}e^{2t} + C\right) = \frac{3}{2}te^{2t} - \frac{3}{4}e^{2t} + c$

2 $x^2 \sin x$

Solution

$\int x^2 \sin x\,dx = uv - \int v\,du$ where $u = x^2$; $du = 2x\,dx$

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

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

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

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

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

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

(3) $\sin 7x \cos 2x$

Solution

$\int \sin 7x \cos 2x$

Recall

$\sin a \cdot \cos b = \frac{1}{2}(\sin(a+b) + \sin(a-b))$

$\sin(9x)\cos(2x) = \frac{1}{2}(\sin 9x + \sin(5x))$

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

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

$= \frac{-\cos(9x)}{18} - \frac{\cos(5x)}{10} + c$

4. $\frac{(2x-3x^2)}{1-x}$

<u>solution</u>

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

$du = 2-6x\,dx$

$dx = \frac{du}{2-6x}$

$\int \frac{u}{1-x} \times \frac{du}{2-6x}$

$\int \frac{u}{(1-x)(2-6x)}\,du = \int \frac{A}{(1-x)} + \frac{B}{(2-6x)}$

multiply through by $(1-x)(2-6x)$

$2x - 3x^2 = (2-6x)A + B(1-x)$

when $x = 1$ when $x = 1/3$

$-1 = -4A$ $1/3 = 2/3 B$

$A = 1/4$ $B = 1/2$

$\int 4(1-x) + \int 2(2-6x)$

$= \frac{4}{2}(x) + \frac{2}{2}(x + c$

$= -2x - x + c$

$= -3x + c_4$