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MATHS 104 ASSIGNMENT

Question 2

integrate the following with respect to their variable.

(1) $\sin 7x \cos 2x \, dx$

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

$$= \frac{\cos 9x}{18} - \frac{\cos 5x}{10} + C$$

(2) $x^2 \sin x$

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

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

$$\int u \, dv = \int x^2 \sin(x) \, dx$$

$$u = x^2 \Rightarrow du/dx = 2x \Rightarrow du = 2x \, dx$$

$$dv = \sin(x) \, dx \Rightarrow \int dv = \int \sin(x) \, dx \Rightarrow v = -\cos(x)$$

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

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

$$u = x \Rightarrow du/dx = 1 \Rightarrow du = dx$$

Thus

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

Since $\int \sin(x)\,dx = -\cos(x)$, this becomes

$$\int x\cos(x)\,dx = x\sin(x) + \cos(x)$$

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

Substitute in $\int x\cos(x)\,dx = x\sin(x) + \cos(x)$:

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

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

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

3 $3te^{2t}$

Solution:

$$\frac{d}{dt}\left[3e^2t^2\right] = 6e^2t$$

- take the constant out

$$(a\cdot f)' = a\cdot f'$$

$$= 3e^2 \frac{d}{dt}(t\,t)$$

$$(f\cdot g)' = f'\cdot g + f\cdot g'$$

$f = t$, $g = t$

$$= 3e^2\left(\frac{d}{dt}(t)\,t + t\,\frac{d}{dt}(t)\,t\right)$$

$= 3e^2 \cdot \frac{d}{dt}[t^2]$

$= 3e^2 \cdot 2t$

$= 6e^2 t$

④ $\frac{(2x-3x^2)}{1-x}$

using quotients rule

$\left[\frac{u(x)}{v(x)}\right]' = \frac{u'(x) \cdot v(x) - u(x) \cdot v'(x)}{v(x)^2}$

$= \frac{\frac{d}{dx}[2x-3x^2] \cdot (1-x) - (2x-3x^2) \cdot \frac{d}{dx}(1-x)}{(1-x)^2}$

$= \frac{\left(2 \cdot \frac{d}{dx}[x] - 3 \cdot \frac{d}{dx}[x^2]\right)(1-x) - (2x-3x^2)\left(\frac{d}{dx}[1] - \frac{d}{dx}[x]\right)}{(1-x)^2}$

$= \frac{(2 \cdot 1 - 3 \cdot 2x)(1-x) - (2x-3x^2)(0-1)}{(1-x)^2}$

$= -\frac{3x^2 + 2x + (2-6x)(1-x)}{(1-x)^2}$

$= \frac{3x^2 - 6x + 2}{(x-1)^2}$