Name: Stella Chinecherem Eusebius-Okon

Department: M.B.B.S

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1) $\int 2x^2 \ln x$

Let $u = \ln x$ $\qquad v = \int 2x^2 = x^3/3$

$\frac{du}{dx} = \frac{1}{x}$ $\qquad \frac{dv}{dx} = 2x^2$

$\Rightarrow 2x^2 \ln x\, dx = 2\int x^2 \ln x\, dx$

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

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

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

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

$\int 2x^2 \ln x = \frac{2x^3 \ln x}{3} - \frac{2x^3}{9} dx$

$\int 2x^2 \ln x = \frac{3 \times 2x^3 \ln x - 2x^3 dx}{9}$

$\int 2x^2 \ln x = \frac{2x^3(3\ln x - 1)}{9} + c$

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

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

2) $\int 3t e^{2t}\, dt$

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

$\frac{du}{dt} = 3$ $\qquad v = \int e^{2t} = \frac{1}{2} e^{2t}$

$$\int 3t e^{2t} dt = \left(3t \cdot \tfrac{1}{2} e^{2t} - \int \tfrac{1}{2} e^{2t} \cdot 3\right) dx$$

$$\int 3t e^{2t} dt = \left(\frac{3te^{2t}}{2} - \frac{1}{4} e^{2t} \cdot 3\right) dx$$

$$\int 3t e^{2t} dt = \left(\frac{3te^{2t}}{2} - \frac{3}{4} e^{2t}\right) dx$$

$$\int 3t e^{2t} dt = \frac{3te^{2t}}{2} - \frac{3}{4} e^{2t} + c$$

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

let $u = x^2$ $\qquad \frac{dv}{dx} = \sin x$

$\frac{du}{dx} = 2x$ $\qquad v = \int \sin x = -\cos x$

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

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

using integration by parts, $u = x$. $\frac{dv}{dx} = \cos x$

$du/dx = 1$, $v = \int \cos x = \sin x$

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

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

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

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

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

4) $\int \cos 5x \cos 6x$

$A = 5x$, $B = 6x$

$\frac{1}{2}$ $\cos A \cos B$ $\quad \frac{1}{2}\left(\cos(A+B) + \cos(A-B)\right)$

$$\int \cos 5x \cos 6x = \tfrac{1}{2}(\cos(5x+6x) + \cos(5x-6x)) dx$$

$$\int \cos 5x \cos 6x = \tfrac{1}{2}(\cos 11x + \cos(-x)) dx$$

$$\int \cos 5x \cos 6x = \tfrac{1}{2}(\cos 11x - \cos x) dx$$

$$\int \cos 5x \cos 6x = \tfrac{1}{2}\left(\frac{\sin 11x}{11} - \frac{\sin x}{1}\right) dx$$

$\int \cos 5x \cos$ …

5) $\int \sin 7x$ …

$A = 7x$ …

Recall

$\sin A \cos$ …

$= \frac{1}{2}$ …

$\int \sin 7$ …

$\int \sin$ …

$\int \sin$ …

$\int \sin$ …

$$\int \cos 5x \cos 6x = \frac{-\sin 11x}{2x} + \frac{\sin x}{2} + c$$

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

$A = 7x, \quad B = 2x$

Recall $\sin A \cos B = \frac{1}{2}\left(\sin(A+B) + \sin(A-B)\right)$

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

$$\int \sin 7x \cos 2x = \frac{1}{2}\left(\sin 9x + \sin 5x\right) dx$$

$$\int \sin 7x \cos 2x = \frac{1}{2}\left(-\cos 9x + (-\cos 5x)\right)$$

$$\int \sin 7x \cos 2x = \frac{1}{2}\left(-\frac{\cos 9x}{9} - \frac{\cos 5x}{5}\right)$$

$$\int \sin 7x \cos 2x = \frac{-\cos 9x}{18} - \frac{\cos 5x}{10}$$