

Math 104

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$$(1) \quad 2x^2 \ln x$$

$$u = \ln x \quad v = \frac{2x^3}{3}$$

$$\frac{du}{dx} = \frac{1}{x}$$

$$du = \frac{1}{x} dx$$

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

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

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

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

$$(2) \quad 3t e^{2t}$$

$$u = 3t$$

$$dv = e^{2t}$$

$$du = 3 dt$$

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

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

$$\int 3t e^{2t} = 3t \frac{1}{2} e^{2t} - \int \frac{1}{2} e^{2t} \cdot 3 dt$$

$$= \frac{3t e^{2t}}{2} - \frac{1}{2} \cdot \frac{3}{2} e^{2t} + C$$

$$\int 3t e^{2t} = \frac{3t e^{2t}}{2} - \frac{3 e^{2t}}{4} + C$$



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

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

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

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

$$\begin{aligned} \int x^2 \sin x &= x^2(-\cos x) - \int -\cos x \cdot 2x dx \\ &= -x^2 \cos x + \int 2x \cos x dx \end{aligned}$$

$$- \left[ \begin{array}{ll} u = 2x & dv = \cos x \\ du = 2 dx & v = \sin x \end{array} \right]$$

$$\begin{aligned} \int 2x \cos x dx &= uv - \int v du \\ &= 2x \sin x - \int \sin x \cdot 2 dx \end{aligned}$$

$$= 2x \sin x - \int 2 \sin x dx + C$$

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

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



$$(4) \cos 5x \cos 6x \quad A = \cos 5x \quad B = \cos 6x$$

$$\cos A \cos B = \frac{1}{2} [\cos (A+B) - \cos (A-B)]$$

$$= \frac{1}{2} [\cos 11x + \cos x]$$

$$\int \cos 5x \cos 6x = \frac{1}{2} \left[ \frac{\sin 11x}{11} + \frac{\sin x}{1} \right] + C$$

$$\int \cos 5x \cos 6x = \frac{\sin 11x}{22} + \frac{\sin x}{2} + C$$

$$(5) \sin 7x \cos 2x \quad A = \sin 7x \quad B = \cos 2x$$

$$\sin A \cos B = \frac{1}{2} [\sin (A+B)]$$

$$2 \sin A \cos B = [\sin (A+B) + \sin (A-B)]$$

$$\sin A \cos B = \frac{1}{2} [\sin (A+B) + \sin (A-B)]$$

$$\sin 7x \cos 2x = \frac{1}{2} [\sin (9x) + \sin (5x)]$$

$$\int \sin 7x \cos 2x = \frac{1}{2} \left[ -\frac{\cos 9x}{9} - \frac{\cos 5x}{5} \right] + C$$

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