

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

$$\text{let } u = \ln x \quad du = \frac{1}{x}$$

$$dv = 2x^2 \, dx \quad v = \frac{2x^3}{3}$$

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

$$= \ln x \times \frac{2x^3}{3} - \int \frac{2x^3 \cdot 1}{3x}$$

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

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

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

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

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

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

$$\text{let } u = 3t$$

$$du = 3$$

$$dv = e^{2t} \, dt \quad v = \frac{1}{2} e^{2t}$$

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

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

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

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

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

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

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

$$A = 7x, B = 2x = \frac{1}{2} [\sin(7x+2x) + \sin(7x-2x)]$$

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

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

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

$$= \frac{1}{2} \left[-\frac{\cos 9x}{9} - \frac{\cos 5x}{5} \right]$$

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

$$\textcircled{3} \int x^2 \sin x \quad u = x^2 \quad du = 2x$$

$$dv = \sin x \, dx \quad v = -\cos x$$

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

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

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

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

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

↑
integrate by parts

$$-x^2 \cos x - 2x \sin x - \int \sin x \, dx \quad \text{let } u = -2x$$

$$-x^2 \cos x + 2x \sin x - \int \sin x + -2 \quad du = -2$$

$$v = \sin x$$

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

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

$$\textcircled{4} \cos 5x \cos 6x$$

recall: ~~$\cos A \cos B = \cos A$~~

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

$$A = 5x, B = 6x = \frac{1}{2} [\sin(5x+6x) - \sin(5x-6x)]$$

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

$$= \frac{1}{2} \int \sin 11x + \sin x$$

$$= \frac{1}{2} \left[-\frac{\cos 11x}{11} - \cos x \right]$$

$$= -\frac{\cos 11x}{22} - \frac{\cos x}{2} + C //$$

$$\textcircled{5} \sin 7x$$

recall

$$A = 7x$$