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Computer Science

①  $\int \sin 7x \cos 2x \, dx$   
Solution

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

Recall,

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

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

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

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

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

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

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

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

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

②  $\int \cos 3x \cos x \, dx$   
 $\int \cos 3x \cos x \, dx$

Recall

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

$$A = 3x, B = x$$

$$\cos A \cos B = \frac{1}{2} [\cos(3x+x) + \cos(3x-x)]$$

$$= \frac{1}{2} [\cos 4x + \cos 2x]$$

$$\int \cos 3x \cos x \, dx = \int \frac{1}{2} [\cos 4x + \cos 2x]$$

$$= \frac{1}{2} \int \cos 4x + \cos 2x$$

$$= \frac{1}{2} \left[ \int \cos 4x + \int \cos 2x \right]$$

$$= \frac{1}{2} \left[ \frac{\sin 4x}{4} + \frac{\sin 2x}{2} \right] + C$$

$$= \frac{\sin 4x}{8} + \frac{\sin 2x}{2} + C$$

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$$(5) \int \frac{\cos x}{\sin^2 x} \, dx$$

$$\int \frac{\cos x}{\sin^2 x} \, dx$$

$$\text{Let } u = \sin x$$

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

$$du = \cos x \, dx$$

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

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$$\text{we have, } \int \frac{\cos x}{\sin^2 x} \, dx = \int \frac{\cos x}{\sin^2 x} \times \frac{1}{\cos x} \, du = \int \frac{1}{\sin^2 x} \, du$$

$$\text{Recall, } u = \sin x$$

$$\int \frac{1}{u^2} \, du = \int u^{-2} \, du$$

$$= \left[ \frac{u^{-2+1}}{-2+1} \right] = \frac{u^{-1}}{-1} = -u^{-1} = \frac{-1}{u} = \frac{-1}{\sin x} //$$

$$(4) \int_1^2 \left( \int_0^3 9x^2 y \, dx \right) dy$$

Solution

$$\int_0^3 9x^2 y \, dx$$

$$= \left[ 3x^3 y \right]_0^3 = 3(3)^3 y - 3(0)^3 y = 81y$$

$$\int_1^2 81y \, dy$$

$$= \left[ \frac{81y^2}{2} \right]_1^2 = \frac{81(2)^2}{2} - \frac{81(1)^2}{2}$$
$$= \frac{324}{2} - \frac{81}{2} = \frac{324 - 81}{2}$$

$$= \frac{243}{2} = 121.5 \text{ or } 121\frac{1}{2}$$