(1) $\sin^2 x + \cos^2 x = 1$

$\sin^2 x = 1 - \cos^2 x$

$\cos^2 x = 1 - \sin^2 x$

(2) $\frac{\sin^2 x}{\cos^2 x} + \frac{\cos^2 x}{\cos^2 x} = \frac{1}{\cos^2 x}$

$\Rightarrow \tan^2 x + 1 = \sec^2 x$

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$\tan^2 x = \sec^2 x - 1$

(3) $\frac{\sin^2 x}{\sin^2 x} + \frac{\cos^2 x}{\sin^2 x} = \frac{1}{\sin^2 x}$

$1 + \cot^2 x = \csc^2 x$

(4) $\sin 2x = 2\sin x \cos x$

(5) $\cos 2x = \cos^2 x - \sin^2 x$

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$$\left.\begin{aligned}\cos 2x &= 1 - 2\sin^2 x\\ \cos 2x &= 2\cos^2 x - 1\end{aligned}\right\}$$

$\sin^2 x = \frac{1 - \cos 2x}{2}$

$\cos^2 x = \frac{1 + \cos 2x}{2}$

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(Ex) $\int \sec^2 x \, dx$

$= \tan x + C$

(Ex) $\int \tan^2 x \, dx$

$= \int (\sec^2 x - 1)\, dx$

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$= \tan x - x + C$

(Ex) $\int \sin^3 x \, dx$

$= \int \sin^2 x \sin x \, dx$

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$= \int (1 - \cos^2 x) \sin x \, dx$

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

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

$\cancel{u = \cos^2 x}$

$\cancel{du = 2\cos x(-\sin x)}$

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$u = \cos x$

$du = -\sin x\, dx$

$= -\cos x - \int u^2 (-du)$

$= -\cos x + \int u^2\, du$

$= -\cos x + \frac{u^3}{3} + C$

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

Ex) $\int \sin^5 x \cos^3 x\, dx$

$= \int \sin^5 x \cos^2 x \cos x\, dx$

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$= \int \sin^5 x (1 - \sin^2 x) \cos x\, dx$

$u = \sin x$

$du = \cos x\, dx$

$= \int u^5 (1 - u^2)\, du$

$= \int (u^5 - u^7)\, du$

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$= \frac{u^6}{6} - \frac{u^8}{8} + C$

$= \boxed{\frac{\sin^6 x}{6} - \frac{\sin^8 x}{8} + C}$

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Ex) $\int_0^{\pi/2} \cos^2 x\, dx$

$(2x)$

$= \int_0^{\pi/2} \left(\frac{1 + \cos 2x}{2} \right) dx$

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$= \frac{1}{2} \left[\int_0^{\pi/2} (1 + \cos 2x)\, dx \right]$

$= \frac{1}{2} \left[x + \frac{\sin 2x}{2} \right]_0^{\pi/2}$

$= \frac{1}{2} \left[\frac{\pi}{2} + \frac{\sin 2 \frac{\pi}{2}}{2} - 0 \right]$

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$$= \frac{1}{2}\left(\frac{\pi}{2} + 0\right)$$

$$= \frac{\pi}{4}$$

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Ex) $\int \sec^2 x \tan x \, dx$

$u = \tan x$

$du = \sec^2 x \, dx$

$$\int u \, du$$

$$\frac{u^2}{2} + C = \frac{\tan^2 x}{2} + C$$

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Ex) $\int \tan^4 x \, dx$

$$= \int \tan^2 x \tan^2 x \, dx$$

$$= \int (\sec^2 x - 1) \tan^2 x \, dx$$

$\cancel{u = \tan x}$

$\cancel{du = s}$

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$$= \int \sec^2 x \tan^2 x \, dx - \int \tan^2 x \, dx$$

$u = \tan x \quad du = \sec^2 x \, dx$

$$= \int u^2 \, du - \int (\sec^2 x - 1) \, dx$$

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$$= \frac{u^3}{3} - \tan x + x + C$$

$$\boxed{= \frac{\tan^3 x}{3} - \tan x + x + C}$$

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