Maths 104 Assignment.

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① $\sin^6 x$

sol

$\int \sin^6 dx$.

$\int \sin^2 x (\sin^2 x)^2 dx$.

$\int \left(\frac{1-\cos 2x}{2}\right)\left(\frac{1-\cos 2x}{2}\right)^2 dx$.

$\int \left(\frac{1-\cos 2x}{2}\right)\left(\frac{1-2\cos 2x+\cos^2 2x}{4}\right) dx$

$= \frac{1}{8}\int 1 - 2\cos 2x + \cos^2 2x - \cos 2x + 2\cos^2 2x$
$+ \cos^3 2x$

$= \frac{1}{8}\int 1 - 3\cos 2x + 3\cos^2 2x + \cos^3 2x \, dx$

$= \frac{1}{8}\int 1 - 3\cos 2x + \left[\frac{1+3\cos 4x}{2}\right] + \cos 2x(1-\sin^2 2x) dx$

$= \frac{1}{8}\int 1 - 3\cos 2x + \frac{1}{2} + \frac{3\cos 4x}{2} + \cos 2x -$
$\cos 2x \sin^2 2x \, dx$

$= \frac{1}{8}\int \cancel{\;}\; 1 - 2\cos 2x + \frac{1}{2} + \frac{3\cos 4x}{2} - \cos 2x \sin^2 2x \, dx$

$$= \frac{1}{8}\left[x - \cancel{x}\,\frac{2\sin 2x}{2} + \frac{x}{2} + \frac{3\sin 4x}{8} - \frac{\sin^3 2x}{6}\right]$$

$$\cancel{\frac{\sin 2x}{2}} \cdot \cancel{\frac{\sin^2 2x}{2}} \cdot \cancel{\sin}$$

$$= \frac{1}{8}\left[\frac{3}{2}x - \frac{2\sin 2x}{2} + \frac{3\sin 4x}{8} - \frac{\sin^3 2x}{6}\right]$$

$$= \frac{3}{8}x - \frac{2\sin 2x}{16} + \frac{3\sin 4x}{32} - \frac{\sin^3 2x}{48} + c$$

(2) $\cos^4 x \sin^3 x$

<u>soln</u>

$$\int \cos^4 x \sin^3 x \, dx$$

since n is odd, $u = \sin x$; $\frac{du}{dx} = \cos x$

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

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

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

$$\int \cancel{\frac{\cos^4 x}{\cos^2 x}} \cdot \cancel{\cos^2 x} \; \cancel{\cos 2x \cos^3 x}$$

$$= \int \cos^2 x \cdot \cos^2 x \cdot u^3 \cdot \frac{du}{\cos x}$$

$$= \int \cos x \cdot \cos^2 x \cdot u^3 \, du$$

$$= \int \cos x (1 - \sin^2 x) \cdot u^3 \, du$$

$$= \int \cos x (1 - u^2)\, u^3 \, du$$

$$= \int \cos x \,(u^3 - u^6)\, du.$$

$\int \cos x\, u^3 - \cos x\, u^6\, du$

$\left[\frac{\sin x\, u^4}{4} - \frac{\sin x\, u^7}{7}\right] + c$

$\left[\frac{\sin x\,(\sin x)^4}{4} - \frac{\sin x(\sin x)^7}{7}\right] + c$

$= \frac{\sin x \cdot \sin^4 x}{4} - \frac{\sin x \cdot \sin^7 x}{7} + c.$

$= \frac{\sin^5 x}{4} - \frac{\sin^8 x}{7} + c$ //

③ $\cos x \sin 3x$

soln

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

$A = x, \quad B = 3x$

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

$\cos x \sin 3x = \frac{1}{2}\left[\sin(x+3x) - \sin(x-3x)\right]$

$\cos x \sin 3x = \frac{1}{2}\left[\sin 4x - \sin -2x\right]$

$\cos x \sin 3x = \frac{1}{2}\left[\sin 4x + \sin 2x\right]$

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

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

$= \frac{\cos 4x}{8} + \frac{\cos 2x}{4} + c$ //