1(a) $\frac{d}{dx}\left(\frac{\ln x}{\sqrt{x}}\right) = \frac{2-\ln x}{2x^{\frac{3}{2}}}$

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

$\frac{1}{2}\int \frac{2-\ln x}{x^{\frac{3}{2}}}\,dx = \frac{\ln x}{\sqrt{x}} + c$

$4\times\frac{1}{2}\int \frac{2-\ln x}{x^{\frac{3}{2}}}\,dx = 4\left(\frac{\ln x}{\sqrt{x}}\right) + c$

$\int \frac{2(2-\ln x)}{x^{\frac{3}{2}}}\,dx = \frac{4\ln x}{\sqrt{x}} + c$

(b) $y = (x-5)\sqrt{x^2+4}$

$= (x-\overset{u}{5})(x^2+4)^{\frac{1}{2}}$

$u = x-5$

$u' = 1$

$v = (x^2+4)^{\frac{1}{2}}$

$v' = \frac{1}{2}(x^2+4)^{-\frac{1}{2}}(2x)$

$= (x-5)\cdot x(x^2+4)^{-\frac{1}{2}} + \sqrt{x^2+4}\,(1)$

$= \frac{x(x-5)}{\sqrt{x^2+4}} + \sqrt{x^2+4}$

$= \frac{x^2-5x+x^2+4}{\sqrt{x^2+4}}$

$= \frac{2x^2-5x+4}{\sqrt{x^2+4}}$

$\int \frac{2x^2-5x+4}{4\sqrt{x^2+4}}\,dx = \frac{1}{4}\int \frac{2x^2-5x+4}{\sqrt{x^2+4}}\,dx$

$= \frac{1}{4}(x-5)(\sqrt{x^2+4}) + c$

2(a) $\int\left(-x^4 + x^{\frac{3}{2}} + \frac{3}{2x^5}\right)dx$

$= -\frac{1}{5}x^5 + \frac{2}{5}x^{\frac{5}{2}} - \frac{3}{8}x^{-4}$

$= -\frac{1}{5}x^5 + \frac{2x^{\frac{5}{2}}}{5} - \frac{3}{8x^4} + c$

2(b) $\int \frac{3}{(5+3x)^2}\,dx$

$= \int 2(3x+5)^{-2}\,dx$

$= 2\int (3x+5)^{-2}\,dx$

$= 2\left[\frac{(3x+5)^{-1}}{3(-1)} + c\right]$

$= -\frac{2}{3(3x+5)} + c$

(c) $\int\left(x + \frac{1}{3x}\right)^2 dx$

$= \int x^2 + \frac{2}{3} + \frac{1}{9x^2}\,dx$

$= \frac{x^3}{3} + \frac{2}{3}x - \frac{1}{9x} + c$

(d) $\int \frac{1+2x^5}{3x^3}\,dx$

$= \frac{1}{3}\int \frac{1+2x^5}{x^3}\,dx$

$= \frac{1}{3}\int \frac{1}{x^3} + \frac{2x^5}{x^3}\,dx$

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

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

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

$= -\frac{1}{6x^2} + \frac{2}{9}x^3\,dx$

3(a) $\int \frac{2e^{3-x}}{e^x}\,dx$

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

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

$= 2\left(-\frac{1}{2}e^{3-2x}\right) + c$

$= -e^{3-2x} + c$

(b) $\int (8+e^x)(3-e^{-x})\,dx$

$= \int (24 - 8e^{-x} + 3e^x - e^0)\,dx$

$= 24x + 8e^{-x} + 3e^x - x + c$

$= 23x + 8e^{-x} + 3e^x + c$

3(c) $\int \frac{7-3e^{4x}}{e^x}\,dx$

$= \int 7e^{-x} - 3e^{4x}\,dx$

$= -7e^{-x} - \frac{3}{4}e^{4x} + c$

3(d) $\int \frac{1}{3^{2x}}\,dx$

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

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

4(a) $\int (2x+3)^{-1}\,dx$ (linear)

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

$= \frac{\ln|2x+3|}{2} + c = \frac{1}{2}\ln|2x+3| + c$

coefficient of $x \rightarrow 2$

(b) $\int \frac{3}{5-x}\,dx$ (linear)

$= 3\int \frac{1}{3-x}\,dx$

$= 3\left[\frac{\ln|3-x|}{-1} + c\right]$

coefficient of $x \rightarrow -1$

$= -3\ln|3-x| + c$

(c) $\int \frac{5}{4(1+5x)}\,dx$ (linear)

$= \frac{5}{4}\int \frac{1}{|1+5x|}\,dx$

$= \frac{5}{4}\frac{\ln|1+5x|}{5} + c = \frac{1}{4}\ln|1+5x| + c$

coefficient of $x \rightarrow 5$

(d) $\int \frac{-2}{\pi x+1}\,dx$

$= -2\int \frac{1}{\pi x+1}\,dx$

$= -2\frac{\ln|\pi x+1|}{\pi} + c$

coefficient of $x \rightarrow \pi$

5(a) $\int (10\cos 2x - 3\sin 4x)\,dx$

$= \int 10\cos 2x\,dx - \int 3\sin 4x\,dx$

$= 10\int \cos 2x\,dx - 3\int \sin 4x\,dx$

$= 10\left(\frac{\sin 2x}{2}\right) - 3\left(\frac{\cos 4x}{4}\right)$

$= 5\sin 2x - \frac{3}{4}\cos 4x + c$

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

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

$= 2\left(\frac{\tan 2x}{2}\right)$ ← coefficient of x

$= \tan 2x + c$

(c) $\int \frac{2}{\sec 10x}\,dx$

$= 2\int \frac{1}{\sec 10x}\,dx$

$= 2\int \frac{1}{\frac{1}{\cos 10x}}\,dx$

$= 2\int \cos 10x\,dx$

$= 2\left[\frac{\sin 10x}{10}\right] + c$ ← coefficient of x

$= \frac{\sin 10x}{5} + c$

(d) $\int \tan^2 3\theta\,d\theta$ $\tan^2\theta + 1 = \sec^2\theta$

$= \int \sec^2 3\theta - 1\,d\theta$

$= \int \frac{1}{\cos^2 3\theta} - 1\,d\theta$

$= \frac{1}{3}(\tan 3\theta) - \theta + c$

$= \frac{1}{3}\tan 3\theta - \theta + c$

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6(a) $\int \sin(3x)\cos(2x)\,dx$ (A, B)

$= \frac{1}{2}\int \sin(3x+2x)+\sin(3x-2x)\,dx$

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

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

$= -\frac{\cos 5x}{10} - \frac{\cos 2x}{4} + c$

(b) $\int \sin(3x)\cos(3x)\,dx$ (A, A)

$= \int \sin 2(3x)\,dx$

$= \int \sin 6x\,dx$

$= \frac{1}{2}\int \frac{\sin 6x}{6}\,dx$

$= \frac{1}{2}\left[-\frac{\cos 6x}{6}\right] + c$

$= -\frac{\cos 6x}{12} + c$

(c) $\int (2\sin^2 3x + 2\cos^2 3x)\,dx$

$= 2\int \sin^2 3x + \cos^2 3x\,dx$

$= 2\int 1\,dx$

$= 2x + c$

(d) $\int \cos 5\theta \cos\theta - \sin 5\theta \sin\theta\,d\theta$

$= \int \left[\frac{1}{2}[\cos(5\theta+\theta)+\cos(5\theta-\theta)] + \frac{1}{2}[\cos(5\theta+\theta)-\cos(5\theta-\theta)]\right] d\theta$

$= \int \left[\frac{1}{2}(\cos 6\theta + \cos 4\theta) + \frac{1}{2}(\cos 6\theta - \cos 4\theta)\right] d\theta$

$= \int \left[\frac{1}{2}\cos 6\theta + \frac{1}{2}\cos 4\theta + \frac{1}{2}\cos 6\theta - \frac{1}{2}\cos 4\theta\right] d\theta$

$= \int \cos 6\theta\,d\theta$

$= \frac{1}{6}(\sin 6\theta) + c$

$= \frac{\sin 6\theta}{6} + c$

(e) $\int \frac{1}{3}\sin^2 2x\,dx$

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

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

$= \frac{1}{6}\int 1-\cos 4x\,dx$

$= \frac{1}{6}\left[x - \frac{\sin 4x}{4}\right] + c$

$= \frac{1}{6}x - \frac{1}{24}\sin 4x + c$

(f) $\int 6\cos^2 3x\,dx$

$= 6\int \cos^2 3x\,dx$

$= 6\int \frac{1+\cos 2(3x)}{2}\,dx$

$= 6\left(\frac{1}{2}\right)\int 1+\cos 6x\,dx$

$= 3\int 1+\cos 6x\,dx$

$= 3\left[x + \frac{1}{6}\sin 6x\right] + c$

$= 3x + \frac{1}{2}\sin 6x + c$