(1) $\int_1^4 \sqrt{x}\,dx$

$= \left[\frac{2}{3}\sqrt{x^3}\right]_1^4 = \frac{16}{3} - \frac{2}{3} = \underline{\frac{14}{3}}$

(2) $\int_e^{e^2} \frac{dx}{x}$

$= [\log x]_e^{e^2} = 2 - 1 = \underline{1}$

(3) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \cos t\,dt$

$= [\sin t]_{-\frac{\pi}{2}}^{\frac{\pi}{2}} = 1-(-1) = \underline{2}$

(4) $\int_0^{\log 2} e^{3x}\,dx$ $\quad e^{3\log 2} = e^{\log 2^3} = 2^3$

$= \left[\frac{1}{3}e^{3x}\right]_0^{\log 2} = \frac{8}{3} - \frac{1}{3} = \underline{\frac{7}{3}}$

(5) $\int_1^2 2^x\,dx$

$= \left[\frac{2^x}{\log 2}\right]_1^2 = \underline{\frac{2}{\log 2}}$

(6) $\int_{-1}^2 (x^4 - x^2 + 1)\,dx$

$= \left[\frac{1}{5}x^5 - \frac{1}{3}x^3 + x\right]_{-1}^2 = \underline{\frac{33}{5}}$

(7) $\int_1^e \left(\frac{x+1}{x}\right)^2 dx$

$= \int_1^e \left(1 + \frac{2}{x} + \frac{1}{x^2}\right) dx$

$= \left[x + 2\log x - \frac{1}{x}\right]_1^e = \underline{e + 2 - \frac{1}{e}}$

(8) $\int_1^2 \frac{(1-x^2)^2}{x^2}\,dx$

$= \int_1^2 \left(x^2 - 2 + \frac{1}{x^2}\right) dx$

$= \left[\frac{1}{3}x^3 - 2x - \frac{1}{x}\right]_1^2 = \underline{\frac{5}{6}}$

(9) $\int_0^1 (e^{\frac{t}{2}} + e^{-\frac{t}{2}})\,dt$

$= \left[2e^{\frac{t}{2}} - 2e^{-\frac{t}{2}}\right]_0^1 = \underline{2\left(\sqrt{e} - \frac{1}{\sqrt{e}}\right)}$

(10) $\int_1^2 \frac{dx}{x(x-4)} = \int_1^2 \frac{1}{4}\left(\frac{1}{x-4} - \frac{1}{x}\right) dx$

$= \frac{1}{4}\left[\log\left|\frac{x-4}{x}\right|\right]_1^2$

$= \underline{-\frac{1}{4}\log 3}$

(11) $\int_0^{\frac{\pi}{2}} (\sin 2x + \cos 3x)\,dx$

$= \left[-\frac{1}{2}\cos 2x + \frac{1}{3}\sin 3x\right]_0^{\frac{\pi}{2}}$

$= \left(\frac{1}{2} - \frac{1}{3}\right) - \left(-\frac{1}{2}\right) = \underline{\frac{2}{3}}$

(12) $\int_1^2 \sin\left(\frac{2}{3}\pi t + \frac{\pi}{4}\right) dt$

$= \frac{1}{\sqrt{2}}\int_1^2 \left(\sin\frac{2}{3}\pi t + \cos\frac{2}{3}\pi t\right) dt$

$= \frac{1}{\sqrt{2}}\left[-\frac{3}{2\pi}\cos\frac{2}{3}\pi t + \frac{3}{2\pi}\sin\frac{2}{3}\pi t\right]_1^2$

$= \frac{3}{2\sqrt{2}\pi}\left\{\left(\frac{1}{2} - \frac{\sqrt{3}}{2}\right) - \left(\frac{1}{2} + \frac{\sqrt{3}}{2}\right)\right\}$

$= -\frac{3\sqrt{3}}{2\sqrt{2}\pi} = \underline{-\frac{3\sqrt{6}}{4\pi}}$

(13) $\int_0^{\frac{\pi}{8}} \sin^2 2x \, dx$

$= \int_0^{\frac{\pi}{8}} \frac{1-\cos 4x}{2} dx$

$= \left[\frac{1}{2}x - \frac{1}{8}\sin 4x \right]_0^{\frac{\pi}{8}}$

$= \underline{\frac{\pi}{16} - \frac{1}{8}}$

(14) $\int_0^{\frac{\pi}{4}} \tan^2 x \, dx$

$= \int_0^{\frac{\pi}{4}} \left(\frac{1}{\cos^2 x} - 1 \right) dx$

$= \left[\tan x - x \right]_0^{\frac{\pi}{4}}$

$= \underline{1 - \frac{\pi}{4}}$

(15) $\int_0^{\frac{\pi}{2}} \sin\frac{5}{2}x \cos\frac{x}{2} \, dx$

$= \frac{1}{2}\int_0^{\frac{\pi}{2}} (\sin 3x + \sin 2x) dx$

$= \frac{1}{2}\left[-\frac{1}{3}\cos 3x - \frac{1}{2}\cos 2x \right]_0^{\frac{\pi}{2}}$

$= \frac{1}{2}\left\{ \left(0 + \frac{1}{2}\right) - \left(-\frac{1}{3} - \frac{1}{2}\right) \right\}$

$= \frac{1}{2} \cdot \frac{4}{3} = \underline{\frac{2}{3}}$

(16) $\int_{\frac{\pi}{6}}^{\frac{5}{6}\pi} \cos t \cos 3t \, dt$

$= \frac{1}{2}\int_{\frac{\pi}{6}}^{\frac{5}{6}\pi} (\cos 4t + \cos 2t) dt$

$= \frac{1}{2}\left[\frac{1}{4}\sin 4t + \frac{1}{2}\sin 2t \right]_{\frac{\pi}{6}}^{\frac{5}{6}\pi}$

$= \frac{1}{2}\left\{ \left(-\frac{\sqrt{3}}{8} - \frac{\sqrt{3}}{4}\right) - \left(\frac{\sqrt{3}}{8} + \frac{\sqrt{3}}{4}\right) \right\}$

$= \frac{1}{2} \cdot \left(-\frac{3\sqrt{3}}{8}\right) \cdot 2 = \underline{-\frac{3\sqrt{3}}{8}}$

(17) $\int_0^{\frac{\pi}{2}} \frac{\cos 2\theta}{\sin\theta + \cos\theta} d\theta$

$= \int_0^{\frac{\pi}{2}} \frac{(\cos\theta + \sin\theta)(\cos\theta - \sin\theta)}{\sin\theta + \cos\theta} d\theta$

$= \int_0^{\frac{\pi}{2}} (\cos\theta - \sin\theta) d\theta$

$= \left[\sin\theta + \cos\theta \right]_0^{\frac{\pi}{2}} = \underline{0}$

(18) $\int_1^2 \frac{\sqrt{x^2 - 4x + 4}}{x} dx$

$= \int_1^2 \frac{|x-2|}{x} dx = \int_1^2 \frac{-(x-2)}{x} dx$

$= -\int_1^2 \left(1 - \frac{2}{x}\right) dx$

$= -\left[x - 2\log x \right]_1^2$

$= -2 + 2\log 2 + 1 = \underline{2\log 2 - 1}$

(19) $\int_0^{\pi} |\cos 2\theta| \, d\theta$

$= \int_0^{\frac{\pi}{4}} \cos 2\theta \, d\theta + \int_{\frac{\pi}{4}}^{\frac{3}{4}\pi} (-\cos 2\theta) d\theta$

$+ \int_{\frac{3}{4}\pi}^{\pi} \cos 2\theta \, d\theta$

$= \left[\frac{1}{2}\sin 2\theta \right]_0^{\frac{\pi}{4}} - \left[\frac{1}{2}\sin 2\theta \right]_{\frac{\pi}{4}}^{\frac{3}{4}\pi} + \left[\frac{1}{2}\sin 2\theta \right]_{\frac{3}{4}\pi}^{\pi}$

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

$= \underline{2}$

(20) $\int_0^{\pi} |\sin x + \cos x| \, dx$

$= \sqrt{2} \int_0^{\pi} \left|\sin\left(x + \frac{\pi}{4}\right)\right| dx$

$= \sqrt{2}\left\{ \int_0^{\frac{3}{4}\pi} \sin\left(x + \frac{\pi}{4}\right) dx + \int_{\frac{3}{4}\pi}^{\pi} \left(-\sin\left(x + \frac{\pi}{4}\right)\right) dx \right\}$

$= \sqrt{2}\left[-\cos\left(x + \frac{\pi}{4}\right) \right]_0^{\frac{3}{4}\pi} + \sqrt{2}\left[\cos\left(x + \frac{\pi}{4}\right) \right]_{\frac{3}{4}\pi}^{\pi}$

$= \sqrt{2}\left(1 + \frac{1}{\sqrt{2}}\right) + \sqrt{2}\left(-\frac{1}{\sqrt{2}} + 1\right)$

$= \underline{2\sqrt{2}}$