(9) Compute $\int_0^{\pi/12} \sec(3\theta)\tan(3\theta)\,d\theta$.

Let $u = 3\theta$ $\quad \theta = \pi/12 \to u = 3(\pi/12) = \pi/4$

$du = 3\,d\theta$ $\quad \theta = 0 \to u = 3(0) = 0$

$\frac{1}{3}du = d\theta$

$$= \int_{u=0}^{u=\pi/4} \sec(u)\tan(u)\left(\frac{1}{3}du\right)$$

$$= \left[\frac{1}{3}\sec(u)\right]_0^{\pi/4}$$

$$= \frac{1}{3}\sec\left(\frac{\pi}{4}\right) - \frac{1}{3}\sec(0)$$

$$= \frac{1}{3}\sqrt{2} - \frac{1}{3}(1)$$

$$= \boxed{\frac{\sqrt{2}-1}{3}}$$

$\sec\left(\frac{\pi}{4}\right) = \frac{1}{\cos(\pi/4)}$

$= \frac{1}{\sqrt{2}/2}$

$= \frac{2}{\sqrt{2}} = \frac{\sqrt{2}\sqrt{2}}{\sqrt{2}} = \sqrt{2}$

(10) Compute $\int_1^2 (6x+3)(x^2+x)^2\,dx$.

Let $u = x^2+x$

$du = 2x+1\,dx$

$3du = 6x+3\,dx$

$x=2 \to u = 2^2+2 = 4+2 = 6$

$x=1 \to u = 1^2+1 = 1+1 = 2$

$$= \int_{u=2}^{u=6} 3(u)^2\,du$$

$$= \left[u^3\right]_2^6$$

$$= 6^3 - 2^3$$

$$= 216 - 8$$

$$= \boxed{208}$$

(11) Compute $\int_{\ln 3}^{\ln 8} e^z \sqrt{1+e^z}\, dz$.

Let $u = 1+e^z$

$du = e^z\, dz$

$z = \ln 8 \to u = 1+e^{\ln 8} = 9$

$z = \ln 3 \to u = 1+e^{\ln 3} = 4$

$$= \int_{u=4}^{u=9} \sqrt{u}\, du$$

$$= \left[\frac{2}{3}u^{3/2}\right]_4^9$$

$$= \frac{2}{3}\left[9^{\frac{3}{2}} - 4^{\frac{3}{2}}\right]$$

$$= \frac{2}{3}\left[3^3 - 2^3\right]$$

$$= \frac{2}{3}\left[27-8\right]$$

$$= \frac{2}{3}\left[19\right] = \boxed{\frac{38}{3}}$$

(12) Compute $\int_e^{e^2} \frac{1}{x \ln x}\, dx$.

Let $u = \ln x$

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

$x = e^2 \to u = \ln e^2 = 2$

$x = e \to u = \ln e = 1$

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

$$= \left[\ln|u| \right]_1^2$$

$$= \ln 2 - \ln 1$$

$$= \boxed{\ln 2}$$

(13) Find $\int \cot\theta \, d\theta$.

$$= \int \frac{\cos\theta}{\sin\theta} \, d\theta$$

Let $u = \sin\theta$

$du = \cos\theta \, d\theta$

$$= \int \frac{1}{u} \, du$$

$$= \ln|u| + C$$

$$= \boxed{\ln|\sin\theta| + C}$$

OR

$$= -\ln\left|(\sin\theta)^{-1}\right| + C$$

$$= -\ln\left|\frac{1}{\sin\theta}\right| + C$$

$$= \boxed{-\ln|\csc\theta| + C}$$

(14) Find $\int \sec x \, dx$.

$$= \int \sec x \, \frac{\sec x + \tan x}{\sec x + \tan x} \, dx$$

$$= \int \frac{\sec^2 x + \sec x \tan x}{\sec x + \tan x} \, dx$$

Let $u = \sec x + \tan x$

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

$$= \int \frac{1}{u} \, du$$

$$= \ln|u| + C$$

$$= \boxed{\ln|\sec x + \tan x| + C}$$

(15) Find $\int 3t^5(t^3+3)^2\,dt$

$$= \int t^3(t^3+3)^2\,3t^2\,dt$$

Let $u = t^3+3 \longrightarrow t^3 = u-3$

$du = 3t^2\,dt$

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

$$= \int u^3 - 3u^2\,du$$

$$= \frac{1}{4}u^4 - u^3 + C$$

$$= \boxed{\frac{1}{4}(t^3+3)^4 - (t^3+3)^3 + C}$$

(16) Evaluate $\int_0^1 x^2 e^{2x^3}\,dx$.

Let $u = 2x^3$

$du = 6x^2\,dx$

$\frac{1}{6}\,du = x^2\,dx$

$x = 1 \rightarrow u = 2(1)^3 = 2$

$x = 0 \rightarrow u = 2(0)^3 = 0$

$$= \int_{u=0}^{u=2} \frac{1}{6} e^u\,du$$

$$= \left[\frac{1}{6} e^u\right]_0^2$$

$$= \frac{1}{6} e^2 - \frac{1}{6} e^0$$

$$= \boxed{\frac{1}{6} e^2 - \frac{1}{6}}$$