KEY **Applied Calculus – Quiz 10**

1. Evaluate $\int_1^4 \left(e^{2x} + \frac{1}{x}\right) dx$ $= \left[\frac{1}{2}e^{2x} + \ln|x|\right]\Big|_1^4$

$= \left[\frac{1}{2}e^8 + \ln 8\right] - \left[\frac{1}{2}e^2 - \underbrace{\ln 1}_{=0}\right]$

$= \boxed{\frac{1}{2}e^8 + \ln 8 - \frac{1}{2}e^2}$

2. Compute $\int \frac{\ln 3x}{x} dx$ $= \int \frac{u}{x} \cdot x\,du = \int u\,du$

① $u = \ln 3x$

② $\frac{du}{dx} = \frac{3}{3x} = \frac{1}{x}$

③ $du = \frac{1}{x}dx$

④ $x\,du = dx$

$= \frac{1}{2}u^2 + C$

$= \boxed{\frac{1}{2}(\ln 3x)^2 + C}$

3. Compute $\int \frac{1}{x \ln x} dx$ $= \int \frac{1}{xu} x\,du = \int \frac{1}{u} du$

① $u = \ln x$

② $\frac{du}{dx} = \frac{1}{x}$

③ $du = \frac{1}{x}dx$

④ $x\,du = dx$

$= \ln|u| + C$

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

4. Compute $\int x^3\sqrt{x^4+1}\,dx$ $= \int x^3 \sqrt{u}\,\frac{du}{4x^3} = \frac{1}{4}\int \sqrt{u}\,du$

① $u = x^4 + 1$

② $\frac{du}{dx} = 4x^3$

③ $du = 4x^3 dx$

④ $\frac{du}{4x^3} = dx$

$= \frac{1}{4}\int u^{\frac{1}{2}} du$

$= \frac{1}{4}\frac{2}{3}u^{\frac{3}{2}} + C$

$= \boxed{\frac{1}{6}(x^4+1)^{\frac{3}{2}} + C}$

5. Compute $\int x^2 e^{x^3} dx$ $= \int x^2 e^u \frac{du}{3x^2} = \frac{1}{3}\int e^u du$

① $u = x^3$

② $\frac{du}{dx} = 3x^2$

③ $du = 3x^2 dx$

④ $\frac{du}{3x^2} = dx$

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

$= \boxed{\frac{1}{3}e^{x^3} + C}$