 Name: SOLUTIONS.

(1) [3] Determine the derivative of $h(x) = \int_2^{1/x^2} \arctan(t)\,dt$.

$$h'(x) = \arctan\left(\frac{1}{x^2}\right)\left(\frac{-2}{x^3}\right)$$

(2) [6] Evaluate the definite integral $\int_e^{e^4} \frac{1}{x\sqrt{\ln(x)}}\,dx \quad = I$

$$\left.\begin{array}{l} u = \ln(x) \\ du = \frac{1}{x}\,dx \end{array}\right\} \begin{array}{l} x = e \Rightarrow u = \ln(e) = 1 \\ x = e^4 \Rightarrow u = \ln(e^4) = 4 \end{array}$$

$$\therefore \quad I = \int_1^4 \frac{1}{\sqrt{u}}\,du$$

$$= \left[2u^{1/2}\right]_1^4$$

$$= 2\left(4^{1/2} - 1^{1/2}\right)$$

$$= \boxed{2}$$

(3) [6] Determine $\int x \cosh(x)\, dx$.

$u = x \quad dv = \cosh(x)\, dx$

$du = 1 \cdot dx \quad v = \sinh(x)$

$$\therefore \quad I = \int u\, dv$$

$$= uv - \int v\, du$$

$$= x\sinh(x) - \int \sinh(x)\, dx$$

$$= x\sinh(x) - \cosh(x) + C$$