Notes:
• Time allowed: 2.5 hours
• Closed book/Closed notes (one 8.5 × 11” sheet of formulas is allowed)
• State your assumptions, methods, and procedures. Show all work.
• Calculators are allowed
• Laptops, cell phones and other electronical devices are not allowed
1a (12.5 points). Integrate
\[ \int \frac{dx}{\sqrt{1+e^{2x}}} \]
(hint: variable substitution?)

1b (12.5 points). Find derivative \( f'(x) \):
\[ f(x) = \frac{xt^2}{t+x^2} \]
2 (25 points). Invert the matrix

\[
A = \begin{bmatrix}
1 & 2 & 1 \\
3 & 1 & 3 \\
1 & -1 & 2 \\
\end{bmatrix}
\]
3 (25 points). Solve the differential equation below for $y(t)$

$\ddot{y}(t) + 2\dot{y}(t) + y(t) = 0$

where

$y(0) = 1, \dot{y}(0) = 0$
4 (25 points). Calculate
\[
\lim_{x \to 2} \sin(\pi x) \sqrt{\frac{|x+2|}{x-2}}
\]