Exam I

Name ________________________________

1. (5pts each) Differentiate the following functions
   (a) $f(x) = \sqrt{25 - x^2}$
   
   (b) $f(x) = 5e^{-0.2x} \sin (0.2x)$
   
   (c) $f(x) = \int_3^7 e^{-2u} \cos (2u) \, du$

2. (5 pts each) Integrate the following
   (a) $\int 4e^{2x} \sqrt{1 - 2e^x} \, dx$
      
   (b) $\int \frac{6x}{\sqrt{1 - x^2}} \, dx$
      
   (c) $\int_0^{\pi/2} \frac{\cos t}{1 + \sin t} \, dt$
      
   (d) $\int x\sqrt{2 + x} \, dx$
3. (5pts) Set up the integral to determine the average value of the function $f(x) = x \arctan x$ on the interval $[1, 4]$.

4. (a) (10 pts) Determine the area of the shown region bounded by the curves $y = 3^x$ and $y = 2x + 1$.

(b) (10 pts) Set up (do not evaluate) the integral for the volume of the solid formed by rotating the region in part (a) about the $y$-axis.
(c) (10 pts) Set up (do not evaluate) the integral for the volume of the solid formed by rotating this region bounded by \( y = 3^x \) and \( y = 2x + 1 \) about the \( x \)-axis.

\[
\begin{align*}
&\text{\( y \)} & \text{\( x \)} \\
&\bullet (1,3) \\
&(0,1)
\end{align*}
\]

5. (10 pts) Set up (do not evaluate) the integral to determine the work needed to empty a full tank of water (62.4 lb/ft\(^3\)) from the top. The tank is parabolic with radius 2 ft and height 16 ft. (In other words, it curves to map the function \( y = 4x^2 \).)

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\begin{align*}
&\text{\( y \)} & \text{\( x \)} \\
&(2,16)
\end{align*}
\]