1. Find the **derivatives**

(a) $\frac{d}{dx}[\, x^4 \cdot e^{3x}\,]$

(b) $\frac{d}{dx}\left(\frac{\ln(5x)}{x^3}\right)$

(c) $\frac{d}{dx}[\, 7^{x}]$

(d) $\frac{d}{dx}(\cosh(\arctan x))$

2. Find y' by **logarithmic differentiation**, if y = $\dfrac{e^{3x}\cdot(x^3+1)^7}{\sqrt[5]{x^2+4}}$

3. Find the **indefinite integrals**.

(a) $\int x^3 \ln x \, dx$ (Use **integration by parts**.)

(b) $\int \frac{x^2}{2+x^3}\, dx$

(c) $\int \sin^6 x \cdot \cos^3 x \, dx$

(d) $\int \frac{dx}{(x^2-4)^{5/2}}$ using **trigonometric substitution**.

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4. Compute $\displaystyle\int_0^2 \frac{x^2}{\sqrt{64 - x^6}}\,dx$

5. Compute $\displaystyle\int_0^{\pi} e^{2x} \cdot \cos(x)\,dx$ using the formula

$$\int e^{au}\cos(bu)\,du = \frac{e^{au}}{a^2 + b^2}(a\cos bu + b\sin bu) + C$$

6. Solve the initial value problem. $\cot(x)\dfrac{dy}{dx} = y$, where $y = 2\sqrt{2}$ if $x = \frac{\pi}{4}$.

7. Let f be a **one to one differentiable function**.
$f(1) = 3$, $f(3) = 5$, $f(5) = 9$, $f'(1) = 4$, $f'(3) = 6$, $f'(5) = 8$
Find $(f^{-1})'(5)$ using the above information and a theorem.

8. Compute $\displaystyle\int_0^1 \frac{2x + 3}{x^2 + 2x + 2}\,dx$

9. Compute $\displaystyle\int_0^4 \frac{dx}{(25 - x^2)^{5/2}}$ using trigonometric substitution.

10. Compute $\displaystyle\lim_{x \to 0} \frac{1 - \cos(x)}{x^3}$

11. Use **Simpson's Rule** with $n = 8$ to **estimate** $\displaystyle\int_0^{16} \sqrt{1 + x^4}\,dx$

(100 points, total.)