Read each problem **very carefully** before starting to solve it. Each problem is worth 10 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points. GOOD LUCK!!

1. Compute the following derivatives:

   (a) $\left(\dfrac{e^{x^3}}{x^2+1} \right)' =$

   (b) $\left(\sqrt[5]{x} \ln (x^3 + 2) \right)' =$

2. Compute the integrals:

   (a) $\displaystyle \int \left(7x^{21} - \frac{1}{\sqrt[3]{x^2}} + \frac{1}{x} \right) dx =$

   (b) $\displaystyle \int \frac{x^7 - 3x^3 + x - x^2 e^{5x}}{x^2} dx =$

3. In a rat infestation at a construction site, it was estimated that, initially, there were 20 rats and that their population increased at the rate of $e^{\frac{1}{5}t}$ rats per month.

   (a) Find an equation for the population of rats $P(t)$ t months from the detection of the infestation.

   (b) At which month would the rat population reach 1000 rats, if no containment measures are taken?

4. Find the area of the region enclosed by $f(x) = 4 - x^2$ and $g(x) = x + 2$. Show all three steps by hand (intersection points, relative position and integral). Do not rely on calculator work.

5. Compute the following integrals:

(a) $\int \dfrac{x^2 + 2}{\sqrt{x^3 + 6x}} dx$

(b) $\int x^4 e^{x^5 + 3} dx$