• Write your name on every exam booklet that you use.
• Show all your work in your exam booklets.
• Circle your final answers and be sure that you have thoroughly explained them.
  Your answers do not need to be simplified.
• No calculators or books are permitted. Students are permitted to bring a single
  $8\frac{1}{2} \times 11$ sheet of paper containing notes, formulas, etc.
• Please turn off cell phones.
• Good luck!

PROBLEMS ON REVERSE SIDE – DO NOT TURN OVER UNTIL INSTRUCTED
1. (a) Find \( \tan^{-1}(-\sqrt{3}) \).
(b) Find \( \cosh(\text{csch}^{-1}(\frac{2}{3})) \).
(c) Let \( f(x) = x^3 + x \). Find all real numbers \( a \) for which the slope of the tangent line to \( y = f^{-1}(x) \) at the point \( (f(a), a) \) is \( 1/28 \).

2. Evaluate the following integrals.
(a) \( \int_0^\pi \frac{\sin t}{2 - \cos t} dt \)
(b) \( \int \frac{e^{\sqrt{r}}}{\sqrt{r}} dr \)
(c) \( \int \frac{dy}{y^2 - 2y + 5} \)

3. Find the derivatives of the following functions of \( t > 0 \):
(a) \( y = t^t \)
(b) \( y = (t^t)^t \)
(c) \( y = t^{(t^t)} \)

4. Find the following limits:
(a) \( \lim_{x \to \infty} \frac{x^3}{3x} \)
(b) \( \lim_{x \to \infty} \frac{\log_3 x}{\sqrt{x}} \)
(c) \( \lim_{x \to 0} (1 + x)^\csc x \)

5. The half-life of radium-226 is 1590 years. If a sample of radium-226 has a mass of 100 mg, find a formula for the mass of radium-226 that remains after \( t \) years.

6. (a) Solve the following initial value problem:
\[ 3y' = 15y + 24e^{3x}, \quad y(0) = 1. \]
(b) Find the general solution to the ODE
\[ \frac{du}{dv} = \frac{u}{1 - v^2}, \]
given that \( u \) is a positive increasing function.